SCIENTIFIC AMERICAN

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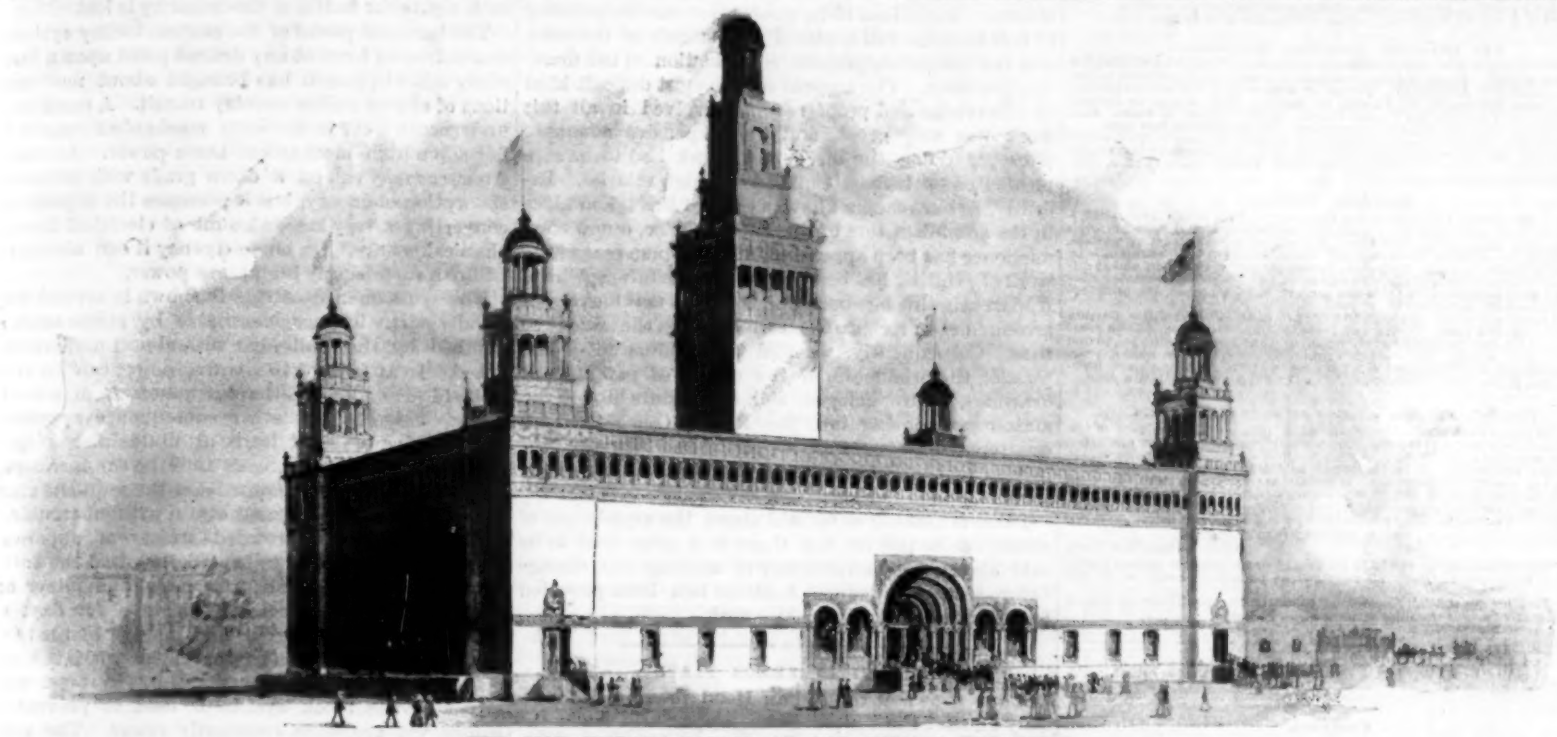
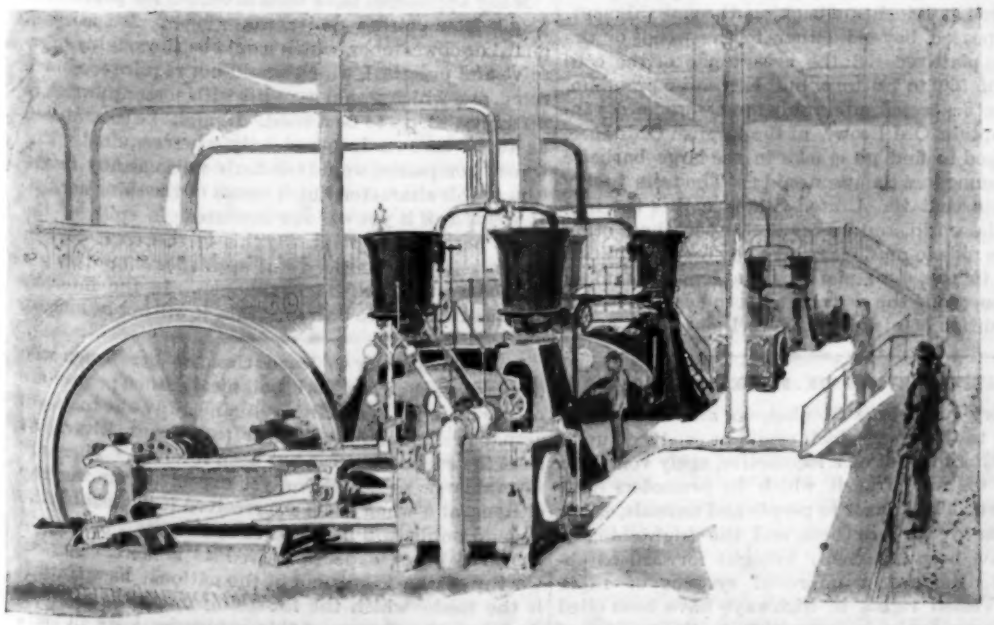
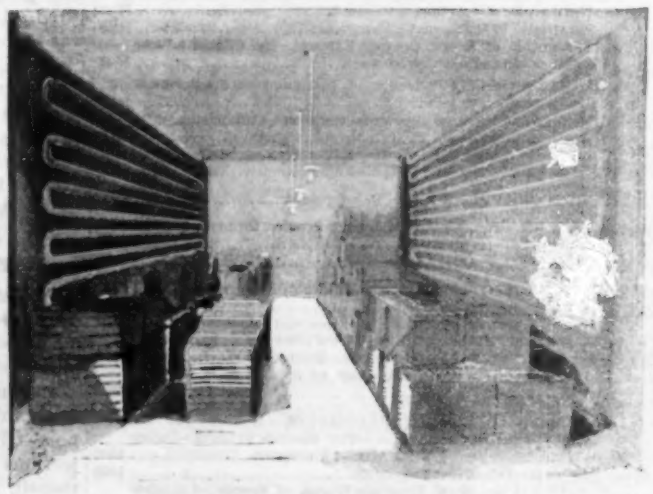


THE COLD STORAGE PALACE AT THE CHICAGO EXPOSITION.

THE GRAND SKATING RINK IN THE COLD STORAGE PALACE.



THE CORLISS ENGINES IN THE COLD STORAGE PALACE.



THE COLD STORAGE APARTMENTS.

THE WORLD'S COLUMBIAN EXPOSITION—THE COLD STORAGE PALACE.—[See page 52.]

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THE DELAY IN THE PUBLICATION OF THE PATENT OFFICE GAZETTE AND OF COPIES OF PATENTS.

The *Patent Office Gazette*, as published during recent years, has fairly ranked as a model for the world. In its printing, illustrating, perfect and complete indexing and general character it has excelled both in typography and in clerical accuracy. When it is considered that each week the claims of some 500 patents had to be printed within its pages, with illustrations of very many of them, it will be seen that the work of doing this satisfactorily and up to date was no slight one. It is questionable if the government received better service from any of its contractors or employes than from those concerned in the publication of the *Gazette*. Incidental to its publication was the printing of half a million full copies of the patents of the week and the photolithographic reproduction of the drawings for them. The amount of the most difficult kind of supervision and proof reading involved in all this work was very great, and the expensive adequate plant for doing the mechanical work had to be supplemented by trained employes at high salaries. Recently, as our readers know, a change has taken place in the administration of the Patent Office, a new commissioner has been appointed, and for some reason the work of printing has been given to some other printer. Apparently this has been done without making proper arrangements for satisfactorily doing the work on time. Consequently, we find the production of the *Gazette*, the production of the copies of patents and drawings, all are delayed, and complaints about the matter are pouring into the Patent Office from all quarters. This is not creditable to the new administration of the Patent Office, and we hope a remedy will be applied quickly.

There is nothing to be said about the expediency of changing the printer, but there is a great deal to be said about the inexpediency of making the change before sure and adequate facilities had been provided for effectively keeping up the work.

AMERICAN ARMOR PLATE.

It was shown at the Indian Head proving grounds, July 11, that the United States apparently leads the world in the manufacture of the strongest armor plates. There were two plates tested, which were to be attacked by three projectiles each. The first test, besides determining whether the 250 tons of armor plate should be accepted, also determined whether the makers should receive $30 a ton in addition to the contract price of $575 a ton. The first plate tested was a 9 inch nickel steel plate weighing 10 tons. The plate was 6½ feet wide by 9 7/12 feet long, and was made by the Carnegie-Frick Company. Three Holtzer projectiles weighing 250 pounds each were fired from an 8 inch rifle, the muzzle being 58 feet from the target. The results of the three tests were as follows:

1. Velocity 1,400 feet per second, penetrated plate and backing to a depth of 11·7 inches. 2. Velocity 1,683 feet, penetrated plate and 3 feet of oak backing; was lost in earth behind. 3. Velocity 1,536 feet, penetrated plate and backing to a depth of 14½ inches. No cracks were perceptible in the plate, which met all the requirements for acceptance without premium, as the second shot lost the makers the premium.

The second plate was made by the Bethlehem Company, and was also made of nickel steel. It was 8⅓ feet high by 12 feet 1 inch in length, and was 17 inches thick. The plate weighed 31½ tons. A 12 inch rifle was used at a distance of 319 feet, and threw Carpenter shells weighing 850 pounds. The result of the tests was as follows: 1. Velocity 1,322 feet per second, penetrated 16·6 inches. 2. Velocity 1,495 feet, penetrated plate and 3 inches of backing. 3. Velocity 1,858 feet, plate penetrated as well as 36 inches of backing, the embankment, and disappeared beyond, either in the woods or the river. The plate secured the acceptance of the contract lot of 500 to 700 tons, but earned no premium. The projectiles acted admirably, and were hardly injured. Captain Ord Brown, of the English Ordnance, was surprised to find no cracks in the large barbette plate. Commodore Sampson said: "The tests to-day demonstrate that the United States makes the best armor in the world, and makes it cheaper than other nations are able to produce it. We pay for the addition of nickel to the steel plate half a cent a pound, or $11.20 a ton, while the French government pays $140 for the addition of nickel to the steel plates."

PROTECTIVE DEVICES ON STREET RAILROADS.

The story of George Stephenson and his famous answer as to the effect which would be produced upon a cow getting in front of a locomotive, aptly voiced an objection to rapid transit which its promoters have always met. The danger to people and animals, either by running over or into them, and the frightening of horses, have been repeatedly brought forward as objections to the use of improved systems of rapid transit. Vested rights in highways have been cited over and over again in opposition to the crossing of the same by steam railroads. In England, famous for its maintenance of personal rights, grade crossings are not admitted, and the integrity of the highway is religiously preserved.

In the United States prescriptive rights seem to have taken less hold upon the people. All sorts of trespasses upon public property are permitted. The subject of improvement of roads and city streets has no sooner been made an issue, macadamized roads no sooner begin to traverse country regions, than streets and roads alike are surrendered to rapid transit companies. All this is done, whether mistakenly or otherwise, with the virtual consent and in furtherance of the views and wishes of the majority. The minority seem to be the sufferers. It is in vested and prescriptive rights that the latter find their protection. With the loss of such rights the battle of the minority is lost.

The immense power of the electric trolley system in concentrating force at any desired point upon a line of many miles in length has brought about new conditions of city as well as country transit. A small motor underneath a car is the only mechanism required to develop a high mechanical horse power. An electric street car may run on a down grade with little or no absorption of energy, but it possesses the capability of converting a very large amount of electrical into mechanical energy. On an emergency it can absorb and utilize a surprisingly high horse power.

The consequence of this is shown in several ways. Grades virtually insurmountable by steam roads are climbed by the trolley car with almost undiminished speed. In an instant the motive power can be raised to its highest pitch, as the car passes from a level to a steep ascent. The other consequence appears in the carrying of great loads at undiminished speed. The crowding of passengers into the car increases its tractive power. The motor takes the requisite energy demanded by the increased strain without trouble.

The presence in crowded streets of abnormally heavy cars, moving at full speed, has had the natural consequences. A number of deaths and minor accidents have been chronicled. Within a few days several deaths have occurred in Brooklyn by the trolley cars. A steam railroad is provided with the most elaborate safety appliances. Gates protect grade crossings, the block system is used to prevent collisions, yet accidents constantly occur. The trolley cars, too heavy to admit of adequate control, run without protection through crowded streets. It would seem that invention should find in them a field for humanitarian work.

A car carrying perhaps eleven or twelve thousand pounds of humanity is driven at the regular running speed by the electric current. It can be almost instantly started. The same form of energy can be applied to stopping it. Electric and electro-magnetic brakes without number have been invented. It would seem as if some way of stopping such a car for an "emergency stop," within a few feet, might save many lives. The motorman may have but a fraction of a second in which to stop his car or to prevent it from striking a human being. A proper electric brake might enable him to work thus quickly. Electricity has the potentiality of doing this. In the system of series arrangement of cars, now little used, the motor itself could act as an efficient brake, by converting the mechanical energy of the moving car into the current form of electrical energy, which again helped to drive the other cars. This interesting feature is lost in the parallel connections of the usual system. The reversing of the present motor, however, is in the line of work suggested, and the motor then appears as a brake in itself. The subjective aspect of the case would call for some method of instantly doing this, without the delay incident to the movement of heavy switches.

Many appliances have been invented for preventing people from getting under the wheels. A successful guard or cowcatcher, which would be thoroughly operative and practical, which would not require too much room, and which would save life with some approach to certainty, seems to be a need. It might be so arranged as to be thrown into use only when required. The transit companies would certainly welcome any invention of this character which would be the thing needed. It seems as if it yet was not invented, in spite of the many patents taken out. If this is the correct view, the inventor of the successful appliance should reap a rich harvest. The field is still open. In the interests of human life it is to be hoped that it will not be long so.

IT is satisfactory to learn that the gentlemen who have urged the New York botanical garden project are nearly now in a condition financially able to begin actual preliminary work near the Bronx River. At least the sum of $215,000 has been received. There are several large subscriptions yet expected from wealthy citizens, and when these are received it is probable the general public will be asked to contribute. There will be no pains or expense spared to make the garden worthy of the State and of the nation. Kew Garden is the model which the far-seeing men who have undertaken the charge of this enterprise have in view, and there is every reason to believe that their efforts will be crowned with success.

A Down-Easter writes home as follows: "The first day I went to the Exposition grounds I was landed on the wooden trestlework of the Illinois Central Railway across the Midway Plaisance by one of the World's Fair express trains. This is the Sixtieth Street station. I fell in with a crowd of five hundred or more people that came on the same train, bent on the same errand that I was, that of seeing the Exposition. It is only about a block from this station to the entrance to the grounds, but there are fakirs enough along this block to satisfy half a million people. Their wares and curious cries swept all unpleasant things of life out of my mind and prepared me to be philosophical and not to be astonished at anything I saw.

"I passed through the gates and almost fell against a sedan chair carried by a couple of baggy-trousered Turks, but they did not mind me, and shambled along, swinging their chair between them. Whether to turn to the right or the left or to go straight ahead was a matter that I could hardly decide, for at the right were the Horticulture and Children's buildings, ahead was the Woman's building, while at the left was the Bureau of Public Comfort and the California buildings. But the two Turks helped me out of my dilemma. I followed them into what looked like a dark hole at the left, but which proved to be a passageway under a viaduct, and it leads into the Midway Plaisance. Up this broad avenue as far as I could see were thousands of people, turrets, minarets, flags of Oriental and other styles, while through the air floated the dulcet strains of bagpipes and grand conglomerations of all sorts of musical instruments, from heathen tomtoms to civilized bass drums.

"I cannot begin to tell all that I saw, but when a gnawing hunger finally asserted itself I realized that it was two o'clock in the afternoon, and that I had spent five hours of my first day and had not been inside of a building in the Exposition grounds. But I had seen sights never to be forgotten. Having dropped the Turks and followed a wheeled chair, which the people here call 'gospel chariots,' because most of the young men who push them are said to be divinity students, I followed the chair to the gateway on the Street of Cairo, and, as I had never been in Cairo, I followed the chair, paid ten cents, and went in. As we entered and went around a corner of the Street in Cairo we came upon a group of camels and donkeys sitting in meek submission around a placard containing the startling announcement: 'Camel ride, 50 cents; donkey ride, 25 cents.'

"Among the many people standing about was a man and his wife, who evidently had a strong hankering to enjoy the experience of camel riding. They made a bargain with the driver of an animal that was resting on a mattress, with his long bony legs doubled up under him. The two took their seats upon the creature with a confident air. The driver jerked at the reins and prodded the camel to induce him to rise. With a sepulchral groan, the poor thing began to obey by putting the different sections of his legs in place, at the same time tossing the passengers and nearly throwing them off. Once on its feet, the camel strode off with a swaying gait that would do credit to the surface of the Atlantic Ocean just outside of Cape Cod. Whoever undertook to ride on the back of a camel furnished amusement for the whole street full of people.

"I was next cognizant of a roar and commotion down the Plaisance whence I had come, and following up the trail of the roar, I found it proceeded from Hagenbeck's animal show, where five live lions in a cage were displayed immediately over the entrance to the building. A trainer was in the cage, showing to the public without cost the influence of mind over beast. It was a temptation to look further into this subject, so I deposited 75 cents in the ticket office, and found myself with many others in an arena filled with cages of most remarkable animals in great variety, and many birds. To me the most attractive animal was the little elephant, Miss Lilly, who stands 36 inches high.

"The animal performances are very wonderful and the entertainment given in this building shows what remarkable results can be accomplished in training wild animals. Here are full grown lions apparently as tame and as docile as the little donkeys in the Street of Cairo. They performed a variety of tricks and the trainer was as familiar with them as though they were the most harmless creatures. Were it not for an occasional roar, and a lion now and then showing the audience his full set of teeth, there would be nothing terrifying or startling about the exhibit.

"After having spent so much of my day in Cairo, Constantinople and the African jungle among the lions, I thought it only patriotic to return to America at least for a time; so I strolled across the street into the factory of the Libbey Glass Works. Here the whole operation of glass making is presented to the view. I saw vases, bottles and other things shaped in imitation of cut glass. I then watched some men who were cutting and polishing glass. But what interested me most in this building was the spinning and weaving of glass. A man would take a piece of glass, hold it in a flame until intensely hot, draw a point out through the flame, attach it to a revolving wheel about six feet in diameter and wind upon the wheel a continuous fine thread of glass. This glass thread seemed to be almost as pliable as though it were made of flax. Adjoining were two young women at a loom weaving fabric of this thread. When completed this glass cloth has a beautiful luster like satin and the attendants assured me that it would stand a good deal of hard usage before breaking. The Princess Eulalia, so I was told, is to have a dress made of glass that was spun and woven in this factory. I could have spent the day here with pleasure, but hunger began to gnaw me.

"I had noticed a little sign over the entrance way to a structure of primitive architecture which assured the public that a farmer's dinner could be had within. I bought a check at the door for fifty cents and took a seat at a plain table, and the waitress gladdened my weary heart when she placed before me an abundant supply of baked beans, brown bread, doughnuts, cheese and coffee, such as had formed part of my diet twice a week for many years just beyond the shadow of Faneuil Hall. Having thus refreshed my inner man, I walked out toward the other end of the Plaisance, where I was lured into a building by what in the Chinese language is called music. I looked over a variety of Chinese wares, had a good view of a paper dragon that had a length of about 125 feet, went up to the second story, where I was led into the mysterious presence of the beings that inhabit the Chinese Joss house.

"Next I watched the Chinese play for nearly two hours, and saw practically the same thing acted over and over again. The scene was evidently a conflict between different claimants for the throne. One claimant after another would come on to the stage, sit on the throne, give a few imperious commands, then retire around the corner, when the next claimant would make his appearance. Three coy Chinese maidens added a little variety to the scene. On two or three occasions, and at frequent intervals, a most diabolical-looking being with immense horns took part in the play.

"Such was my first day. I had not seen a thing directly connected with the Exposition, yet probably in no day of my life shall I again see so many people from all parts of the world and so many interesting and instructive objects as I saw on this one day.

"But this was only my beginning at the great Fair. To-morrow I will tell you a heap more."

In the section of horology the genius and ability of the French for original work and delicacy of execution is finely shown. Several watches are exhibited which have a face half an inch in diameter. One of these watches, which is claimed to be the smallest one in the world, is set in a rosebud studded with stones. A clasp at the point of the bud keeps it closed, and when pressed, springs open, revealing this miniature watch. This watch is wound up by turning the entire watch. A gold enamel ring has a similar watch set in it in a nest of about one hundred small diamonds. We here give an engraving showing the exact size of this remarkable specimen of fine mechanism. Several novelties in watches for ordinary use are also exhibited. One watch is so constructed that every time the case is opened to see what time it is, then closed again, the spring is wound up. This watch is a repeater, striking the hour and the minutes. Another watch has two faces, one on each side. One face gives the second, the minute, and the hour of the day, notes with a pointer how nearly the watch is wound up, and has two small faces, so that the time of different cities in the world can be shown. Turning the watch over and opening the rear case, there is found a perpetual calendar, which gives the day of the week, the day of the month, the month of the year, the phases of the moon, and it also contains a thermometer. The watches in this one case are estimated to be valued at about $400,000.

Watches are shown in the Swiss department which display equal cunning in this line of manufacture. The ring illustrated herewith, showing a watch set in the crown, is reproduced in actual measurement, and represents the full size of the ring. The watch itself is set in a circle of twenty-four diamonds, and, like the watches referred to in the French department, it is wound up by turning the entire watch upon its setting. Other miniature watches are shown in this exhibit, which are mounted as butterflies, beetles, and ducks. There is also a daisy made of gold and enamel, the center being one of these miniature watches.

The fine exhibit of the Oil Well Supply Company, of Pittsburg, is situated back of the Machinery Hall Annex. A huge derrick and all the machinery necessary for drilling a 3,000 foot well are in place.

The illuminated fountains are now in running order. The central jet rises 95 feet, the largest nozzle is 1¾ inches in diameter. The current for the lamps is 90 amperes.

The total number of paid admissions to the Columbian Exposition from May first to July fifteenth is 5,158,523.

In the Swedish section of the Fine Arts building there is a wood carving, No. 188, entitled "Columbus' Arrival in America." It is by A. E. Norman, a Swede by birth, who had learned the trade of carpenter, but received no special instruction in wood carving. The specimen of his artistic skill in exhibition is highly creditable. It was cut from a solid block of Turkish boxwood a foot square and eight inches thick. The central figure is of course Columbus, and he is shown just as he is in the act of stepping ashore from the Santa Maria's cutter, one foot being on the gunwale and the other on the soil of the New World. He holds aloft the standard of Castile and Aragon and a drawn sword. The accessories are all appropriate and are very skillfully treated. Above and around the discoverer is the typical vegetation of the West Indies. In the remote distance the Santa Maria rides at anchor. Near by a native chief and a maiden regard the pale stranger with awe and wonder. The execution is careful throughout.

The custodian of the Presbyterian exhibit sits daily on the unopened cases in the Liberal Arts department like Marius amid the ruins of Carthage, and there he will sit until the Exposition closes. The Presbyterians will not allow a nail to be drawn from the cover of one of the boxes while the Fair is open Sundays, and the Exposition authorities refuse to allow the cases to be removed until the Fair closes for good and all. The public do not miss much.

The exhibit of the Century Company in the north gallery of the Manufactures building is very complete. The various processes of wood engraving, electrotyping, and photo-engraving are exhibited in detail. For example, a sheet of copy is shown, then the type locked up in a form, followed by the proofs with the reader's marks upon them, then the electrotype and finally the printed page. "How a dictionary is made" is also shown, the great "Century Dictionary," of course, being chosen. The original drawings from which many of the cuts were produced, one of the wood engraver Cole's exquisite blocks, the engraving being done directly from one of the paintings by an old master in Florence, are also on exhibition. Parts of the original manuscript of "Little Lord Fauntleroy," "Abraham Lincoln," etc., are shown, as well as some of George Kennan's *Century* articles which have been rendered illegible by the Russian police authorities. Many valuable autograph letters are on exhibition. The booth is built in excellent taste, is beautifully decorated, and the whole exhibit is very creditable to the great magazine.

On July 7 the Spanish caravels, being the reproduced fleet with which Columbus sailed on his voyage of discovery, reached Chicago from New York and Cadiz, and anchored in the open roadstead, immediately in front of the Palace of Manufactures and Liberal Arts, at the World's Columbian Exposition. These vessels were illustrated in the SCIENTIFIC AMERICAN of April 29. It was a beautiful day on which they reached Chicago. The fleet left Milwaukee the previous day and was joined early Friday morning, many miles north of Chicago, by the United States war vessel Michigan and the revenue cutter Andrew Johnson. As they approached Chicago many other vessels joined in the escort, and a grand procession was formed which proceeded slowly up to the Exposition grounds, where joyous salutes of cannon were fired. The rich-toned chimes in the German building pealed forth their notes of welcome, while thousands of people who lined the shores joined in with cheers and waving of handkerchiefs.

Lieutenant Commander Berry, of the Michigan, then came ashore, followed by Captain Victor Concas, who commanded the caravels and brought them through their long journey of 147 days from Cadiz to Chicago.

The reception of the guests was as appropriate in its way as was that of Columbus himself when he first stepped on land in the New World. The guests were escorted to a temporary platform adjoining the Administration building, where they were greeted by prominent United States officials and representatives of almost every nation in the world.

Addresses were made by President Palmer of the Exposition, Senator Sherman, Captain Concas, Secretary Herbert, Mayor Harrison and Frederick Douglass. Spanish airs and other music were interspersed, and rousing cheers were given for the little King of Spain, Alfonso XIII., and his mother, the Queen Regent,

(*Continued on page 54.*)

THE COLD STORAGE PALACE AT THE COLUMBIAN FAIR AND ITS DESTRUCTION BY FIRE.

Early in the work of planning the Columbian Exposition, arrangements were made for a cold storage plant that should not alone be a model of its kind, but also serve the Exposition in the same capacity that similar plants serve all the cities of any importance. Manufacturers of ice-making machinery were called into consultation, and a contract for the erection of such a plant was made with the Hercules Iron Works, Chicago. Space was assigned for this plant immediately south of the Sixty-fourth Street entrance to the Exposition grounds, and the Hercules Company at once began work on the imposing structure shown in the accompanying illustration. The building covered a space of 255 × 130 feet in size and was built five stories high. There was no need for windows in the building, because of the manner in which the space inside was utilized, except on the fifth or top floor, which was fitted up as a skating rink. At each corner an imposing tower was built, rising to a height of 115 feet above the ground.

A tower rising to a height of 225 feet, somewhat similar in architecture to the tower on Madison Square Garden in New York City, was built, through which rose the smokestack.

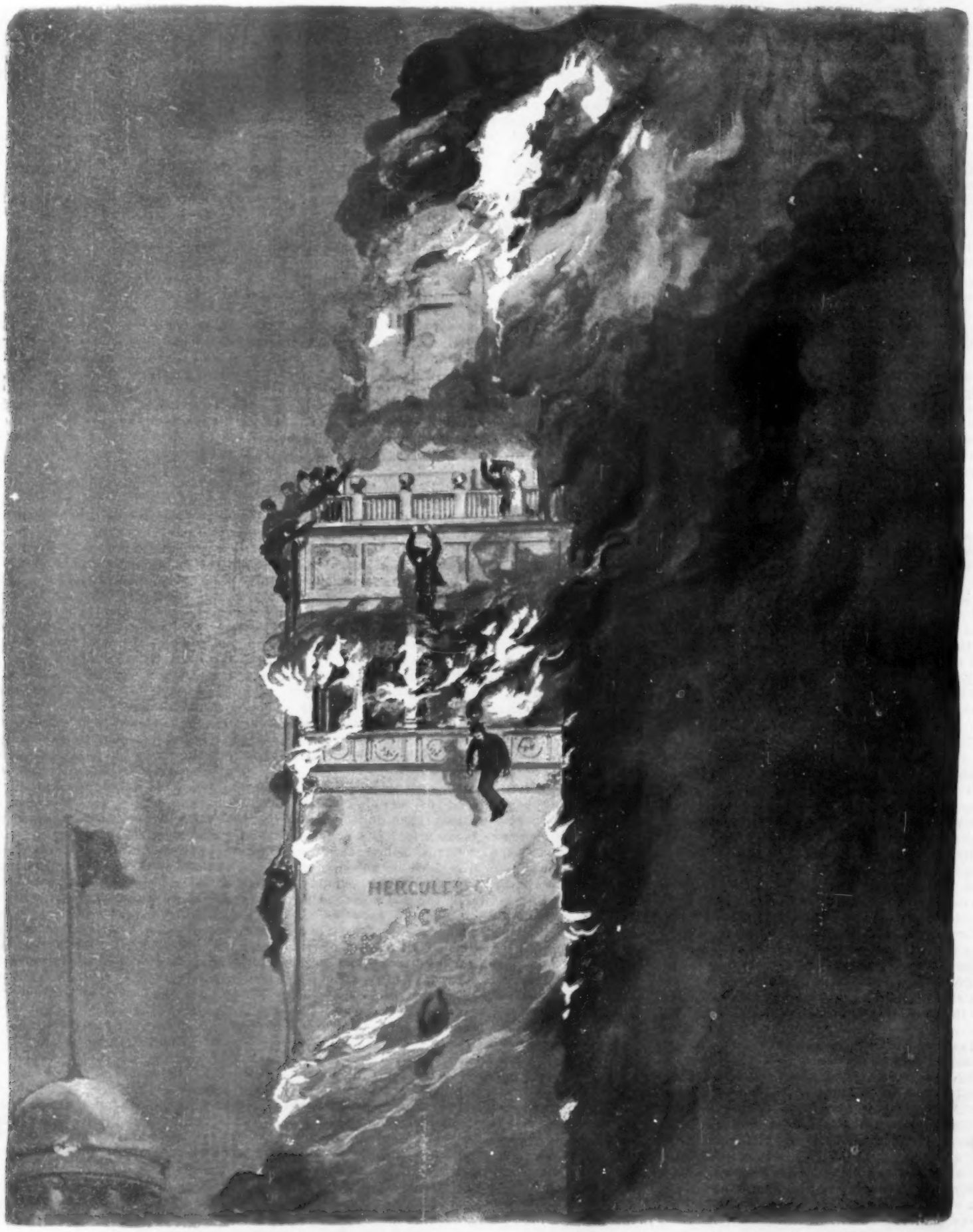
The general architectural effect of the building was very pleasing and striking. The upper engraving on our front page illustrates the appearance of the structure. The building was constructed of staff.

The central part of the building was occupied by the ice-making machinery. The engine room proper was 80 feet square and two stories in height. Two Hercules ice-making machines of 120 tons each and another of 60 tons capacity occupied this room, together with dynamos which provided current for lighting the building. There were also air pumps for operating the hoists in the cold storage house and other necessary machinery. Just back of this room was the boiler room, with batteries of boilers aggregating 700 horse power and apparatus to provide the condensed water for manufacturing the ice.

In the south or left end of the building were the ice tanks, and the work carried on here was in full view of visitors. The can and plate systems for making ice were both used. The ice was removed from this room to the ice storage house immediately in the rear, which occupied a space of 100 × 40 feet, and was two stories high. One hundred or more tons of ice were manufactured each day, and a supply of a thousand tons or more was kept constantly on hand in the storage house, as the entire supply of ice for the Exposition grounds was furnished from this plant.

At the north end, or right hand, of the building as illustrated were the cold storage and freezing rooms, affording over six hundred thousand cubic feet of cold storage and freezing space, divided into rooms of various sizes for restaurant keepers, exhibitors, and others in the Exposition grounds.

The Hercules Company concluded, at an early period, to add the novelty of a skating rink, with real ice. Such a rink was established, affording a skating surface of 208 feet long and 54 feet wide. Our central illustration on the front page shows the appearance of this remarkable apartment. Our special artist in



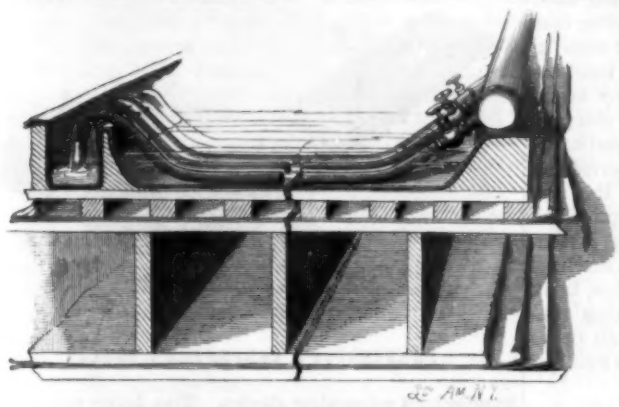
THE WORLD'S COLUMBIAN EXPOSITION—DESTRUCTION BY FIRE OF THE COLD STORAGE PALACE, JULY 10, 1893.

Chicago, who witnessed the terrible occurrence, sends the sketch we herewith present. The manner in which the floor was arranged to provide for the necessary ice is shown in the accompanying cut, in which the manner of arranging the brine pipes is given. Four thicknesses of specially prepared paper were laid over the entire floor. Upon this a false floor was constructed making every allowance and affording every facility for proper ventilation. On this false floor more insulating paper was laid, covered by a tank made of lead. One inch pipes for conveying the brine were laid lengthwise of the room, four inches from center to center, connected to a larger main supply pipe four inches in diameter, at one side of the tank. By a stopcock connection the volume of brine was regulated. The brine from the main header, passing through these pipes, discharged into the trough at the opposite side. From this trough the brine was conveyed to the brine tank, and after proper cooling was again used.

The brine was turned into these pipes on July 3, and half the floor was satisfactorily frozen on July 10. The depth of ice designed to be obtained was six inches, and the surface of this was to be kept hard and smooth by flushing it when needed with water, which would freeze and give a new surface.

About 1:30 P. M., July 10, our Chicago correspondent went to the cold storage plant, and while in the office on the third floor, the alarm was given that the building was on fire. Every body in the office ran for their lives and successfully escaped.

It appears that flames had been discovered issuing from the extreme upper part of the tower, caused, as it now appears, from defective protection of the iron chimney which passed up through the tower. The firemen were quickly on hand, and a company of them twenty strong at once ascended the tower to the balcony just above the columns, as shown in our engraving, and here they were engaged with ropes in drawing up the hose pipes, to extinguish the flames above them, when, all of a sudden, to the horror of the spectators, the flames fiercely burst out from the lower part of the tower, far below where the firemen were at work. The retreat of the hosemen was thus



FLOOR AND BRINE PIPING ARRANGEMENT.

instantly cut off. Some of them tried to slide down the rope, which burned before they could do so; the others jumped and were mangled by the fall of a hundred feet to the main roof below. In all some twenty firemen lost their lives. It seemed scarcely two minutes after the flames broke out below before the whole tower was a mass of flames and then fell down upon the roof of the main building, which burned and roared as if it were a mass of shavings.

The engineer in charge of the boilers had the courage and forethought to draw the fires and liberate the steam before fleeing. By this delay he barely escaped with his life; but he probably saved the lives of many people, and prevented the destruction of much more property. The heat from the fire was intense, blistering buildings as far away as the Transportation building.

The monetary loss is estimated at about $200,000, with probably not over $10,000 insurance. It is believed that the number of lives lost will be fifteen, if not twenty.

TEST OF BEARING POWER OF PILES.

Before beginning the masonry for the Chicago Public Library building, which was to rest on pile foundations driven in clay, it was decided to submit a number of piles to a careful test to determine whether the assumed load of 30 tons per pile was safe. The test was made by the contractors for the foundation work under the supervision of Mr. Nicholas E. Weydert, Superintendent of Buildings, Chicago, Ill. A platform 7 feet × 7 feet, consisting of 12 × 12 inches yellow pine timbers resting on steel I-beams 15 inches deep, was placed on four piles, and on this platform pig iron was piled to a height of 38 feet. This arrangement is clearly shown in the accompanying illustration. The following is an abstract of Mr. Weydert's report on the test, which was published, with the accompanying cut, in *Engineering News:*

The test was commenced in the morning, January 6, a week after the piles to be tested had been driven. The surveyors marked points on top of the piles and took levels on them after the pig iron had been piled to a height of 4 feet, and the load was about 45,200 lb. This piling up of the pig iron continued irregularly, owing to the severe weather, until January 10, when it had attained a height of 21 feet and a weight of 224,500 lb. Levels were taken, but no settlement was discoverable. January 17, at 2 P. M., all the pig iron had been piled on; it had then reached the height of 38 feet, and the load on the four piles was about 404,800 lb., or about 50·7 tons per pile. January 18, levels were taken and no settlement was discovered. These levels were repeated January 20, after the above load had remained for three days; also January 28, after the load had remained for eleven days, in both cases no settlement being observable. Further tests not being deemed necessary, and the test hindering the progress of the work, orders were given January 29 to proceed with the removal of the pig iron. The four piles, therefore, sustained a load of a little over 50 net tons each for practically a fortnight, without giving any indication of settlement.

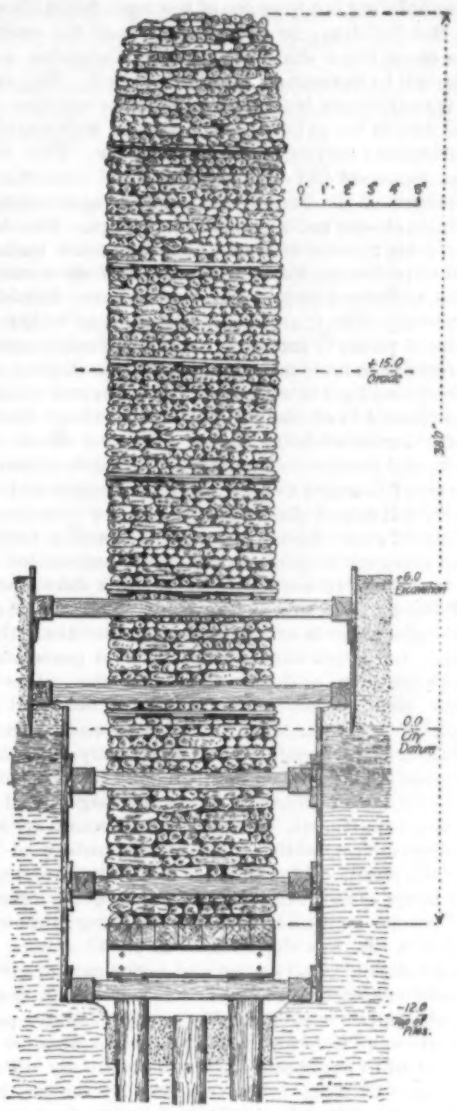
The piles were driven by a steam hammer of the Nasmyth type, made by the Vulcan Iron Works; weight 4,500 pounds; fall 42 inches, making 54 blows per minute. The last 20 feet were driven with a follower of oak. It was found that it required 48 to 64 blows to drive the last foot with the follower, and as the ratio of blows without follower to blows with follower is as one to two, it may be estimated that it would have required from 24 to 32 blows of the above hammer to drive the last foot directly, without follower. In the same soil it required about 16 blows of a drop hammer weighing 3,000 pounds and falling 30 feet to drive the last foot, with a follower, as above, and 32 to 36 blows of the same drop hammer falling 15 feet with a follower.

The piles were driven 2½ feet between centers, nearly, three in a row along the trench. This is deemed to be as close as they can be driven with ease. They were about 54 feet long and were driven about 52½ feet. They had an average diameter of 13 inches, circumference of 41 inches, and an area at tip of 80 square inches. If a pile similar to the test piles is left for 24 hours, it is found that it requires 300 to 600 blows of the above described hammer to drive it the last foot, or a repetition of 300 to 600 blows of 189,000 inch pounds each. The heads of the piles, after being sawed off, were 27 feet below the street grade, and the tips about 80 feet below the same. They were driven about 27 feet in soft, plastic clay, 23 feet in tough, compact clay, and 2 feet in hard pan. The bearing power of this hard pan may be estimated by Rankine's formulas at 170 pounds per square inch, and by empirical results at 250 pounds per square inch; in this case it may be a fair assumption that it would carry 200 pounds per square inch. The extreme average frictional resistance per square inch of sides of piles like those described, as deduced from experiments made under analogous conditions, may be placed at 15 pounds per square inch.

The average area of the tip of the above piles is 80 square inches. Therefore, their extreme point resistance will be 16,000 lb. The average surface of their sides is about 25,000 square inches, so that their total extreme frictional resistance will amount to 375,000 lb. As the point resistance in comparison to the latter is but small, it may be neglected, and the ultimate bearing capacity of a pile similar to the test piles may be estimated at 375,000 lb., or about 180 tons. But inasmuch as the ultimate crushing strength of wet Norway pine may not be over 1,600 lb. per square inch, or using a factor of safety of 3, 533 lb. per square inch, and whereas the minimum area of piles specified to be not less than 8 inches at the tip and 16 inches at the butt is about 113 square inches, each pile should not carry more than 60,000 lb., or 30 tons. This provides a factor of safety of 3 for the crushing resistance of the timber, and a factor of safety of 6 for the frictional resistance of the soil. If the timber be loaded to one-half of its ultimate strength, a load of 90,000 lb., or 45 net tons, may be assigned to one pile. But in the Library building, the conservative load of 30 tons per pile was adopted, which gives assurance that this building will not be likely to suffer from any want of strength in its foundations.

Milk Adulteration.

At the Paisley Sheriff Court an interesting point has been raised and decided. Some time ago a woman who retailed milk was prosecuted under the Food and Drugs act and was fined for adulteration. The farmer who sold her the adulterated milk raised an action against her for the price of it, but she refused to pay, alleging that she was entitled to set against the account the amount of the fine and expenses connected with the prosecution. Evidence was given to show that repeated complaint had, previously to the prosecution, been made to the farmer without effect, and that the milk, for the sale of which the woman was convicted, was sold exactly as it had been received. The sheriff held that the conviction under the Food and Drugs act was right, as the milk had undoubtedly been much adulterated with water. He further held that the woman, having sold the milk as she received it, was entitled to recover from the farmer the fine and

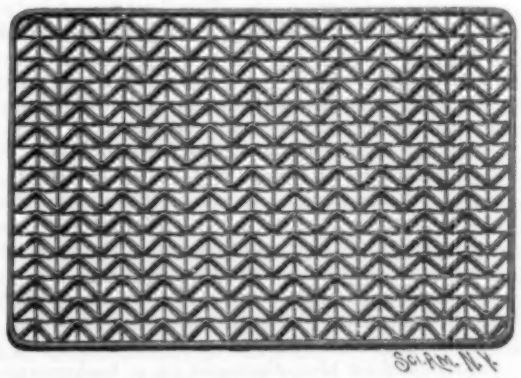


METHOD OF TESTING FOUNDATION PILES OF PUBLIC LIBRARY BUILDING, CHICAGO.

expenses of both actions, amounting to the sum sued for in the present action, and he gave judgment accordingly.

AN IMPROVED WIRE MAT.

This is a mat which is comparatively inexpensive to manufacture, and is very durable, while most efficiently serving the purpose for which such articles are designed. It has been patented by Mr. Joshua Horrocks, of No. 45 Cliff Street, New York City. The wire netting of this mat is braced in all directions, the wire meshes being crossed by continuous metal strips whose edges extend beyond opposite sides of the meshes, thereby forming a rigid structure well adapted to resist wear. The metal strips crossing the meshes are of a serpentine or zigzag construction, and their



HORROCKS' WIRE MAT.

edges face upward and downward, thus presenting surfaces which act most efficiently in removing dirt and foreign matters from the boots and shoes of those using the mat. This mat body structure is well adapted for various other uses, such as gratings, fencings, panels, etc.

ONE HUNDRED YEARS OLD, STILL IN PRACTICE.—Dr. DeBossy, of Havre, has passed his hundredth year. He is still in active practice, and at a dinner given in honor of his hundredth birthday, he made a speech in which he stated that his father had lived a hundred and seven and he intended to do the same.—*Med. Compend.*

WORLD'S FAIR NOTES.

(*Continued from page 51.*)

also for Spain, the Spanish navy and the Spanish people.

The French exhibit in the Manufactures and Liberal Arts building occupies one of the most desirable spaces in the building, as it is situated near the center by the clock tower and extends from Columbia avenue through to the east side of the building. The exhibit of manufactures is on the ground floor and that of liberal arts in the gallery, with private stairways in the department leading to the gallery floor. This exhibit was organized and arranged under the immediate supervision of the French government, and exhibits of certain classes are arranged in groups. The largest and most noticeable of these exhibits come under the following heads: *Furniture and interior decoration.*—This includes a large variety of interior furnishings, especially the gracefully designed and richly ornamented pieces of furniture for which French manufacturers are so famous; also a very large display of tapestries and other wall hangings. Several rooms are reproduced in all their furnishings, perhaps the most richly furnished being that of a drawing room. *Ceramics and mosaics.*—There are five exhibits of manufacturers of Limoges ware, which are extensive and which cover full sets of dishes as well as a few representative dishes of sets. Each display is artistically arranged, and although a comparatively small amount of space is occupied, in each exhibit there is shown perhaps $25,000 worth of this famous ware. The exhibit of artistic glassware is considerably smaller than that of china, but much ornamental work in porcelain and glass is shown, and also of Sevres ware. One large room, richly decorated, is filled with beautiful specimens of this ware. Many small vases and half a dozen or more richly decorated and artistically shaped vases of large size are shown in this room. *Art metal work.*—The display of bronzes is one of the largest and finest in this department. Many of these bronzes are groups and statuettes, while others are electroliers of equal artistic merit. Many of these electroliers are designed for lamps of small candle power and are a revelation in artistic skill and taste in designing illuminating fixtures. In this department as in all others duplicates are sold of all pieces, and as the card of each purchaser is attached to the article purchased, the taste of the public can be readily gauged. Many popular figures have from fifteen to twenty-five or more cards attached to them, and these usually are by no means the ones of most artistic merits. By far the richest bronze exhibited is the Doré vase, a piece of much size and so artistically and elaborately ornamented as to require the closest study to appreciate the work that has been done on it. Besides the regular bronzes there are several exhibits of cheaper forms of bronzes as well as of imitation bronzes of plaster or other materials bronzed over.

Threads and Fabrics.—This is a department in which French manufacturers are so well known to excel in many lines of goods, and the rooms in which these exhibits are shown are usually crowded with women, especially in the sections devoted to clothing, costumes and accessories of the toilet. These exhibits include fabrics of all kinds, more especially those made of silk, and they are fabrics more in the line of personal decoration rather than other uses. Many large cases are filled with gowns, displaying the latest Paris fashions. Hats, bonnets, and kid gloves are also shown. The display of laces is very complete and includes many beautiful and costly specimens of work.

Jewelry and Ornaments.—This department includes a line of work in which the French so excel that it vies with the costumes section in popularity. Several exhibits of imitation jewelry are at all times surrounded by groups of visitors who have better use of superlative adjectives than judgment of precious stones, for adjoining the cases in which these imitations are shown, and which represent only a few thousands of dollars in value, is an exhibit of genuine stones that is estimated to represent about $2,000,000 worth of goods. In the center of this case is shown a necklace and pair of earrings valued at $106,000. The necklace is made up of eleven diamonds of as many different colors, each diamond joined to the necklace proper by a diamond setting. Just above this necklace is a pin composed of six blue diamonds on a background of yellow diamonds, which is valued at $160,000. The largest stone in this pin weighs forty-one carats and in itself is valued at $100,000. Just at the left of this is another pin composed of five whitestones which has a price of $140,000. The largest stone, weighing forty-three carats, is valued at $53,000. There is also shown in this case a prayer book printed in the fifteenth century, and before Columbus discovered America, in a binding of gold and silver enamel inlaid with rubies. At the right in the case is a tiara of diamonds from the crown jewels that was worn by the Empress Eugenie.

Printing.—Printers and everybody interested in the printer's art will find the department in which this art is exemplified from a mechanical standpoint very complete. This department is located in the Palace of Mechanic Arts. Two very old printing presses are shown in this department, one of which was made in Boston in 1742. The other old press is of similar type, and is almost identical with the old Benjamin Franklin press shown in the Smithsonian Institution, at Washington. This press uses an iron impression screw instead of a lever, such as is used on some old presses. This latter press is believed to be 150 years old. It was in use at the time of the Revolution, and was also used during the late Rebellion for printing Confederate money. General Lee's farewell address to his army was printed on this press. Outside of these two ancient models, the other presses exhibited illustrate every variety of press that is in successful operation to-day. These include presses for every purpose and of various speeds, from the small press for printing cards or circulars to the monster quadruple inserting perfecting presses that print newspapers of eight, ten, twelve or more pages at the rate of about 40,000 an hour. Many of these presses are shown in operation. One large lithographic press that prints pictures in colors of the Exposition buildings and grounds is the center of much interest. The Chicago evening papers print editions each afternoon in this department. In the stereotyping department no new processes for stereotyping are shown, but complete outfits of different type and manufacture of the generally used process are exhibited. Type-setting machines of four different styles are also shown in this department in operation. These include both the machines that set ordinary type as well as those that cast the entire line from matrices. The *Daily Columbian*, the official organ of the Exposition, is printed in this department, and the composition is done on one of these type-setting machines. Printing several colors at the same time is also illustrated by several exhibits of presses for this purpose.

The art of making type is illustrated in a historical manner that makes it one of the most complete exhibits in this building, as the process of type making is fully shown by exhibiting machines illustrating the development of this art. This interesting exhibit begins with the old hand moulds, such as were used one hundred years ago, each letter or type being cast in a slow and uncertain manner. The next step in advancement is in the rotary type-casting machine invented in 1840, and which was operated by hand. Thirty years later steam power was applied for this purpose, making a machine which would seem remarkable even in these days, were it not for the type-perfecting machine of 1893, which is shown alongside the machine of 1870. This latest invention casts type at the rate of 160 to 180 a minute, each type being perfect in every respect and ready for use, It is a machine of marvelous ingenuity. Wooden type, presses, book binders' machinery, thread and wire stitching machines, cutters, perforating machines, and all other devices used in printing establishments are likewise shown.

Two of the British royal commissioners, James Dredge and Walter T. Harris, who have just returned to England, sent a letter to President Higinbotham, of the Exposition Company, in which they express themselves, regarding the Fair, in a manner that reflects the sentiments of every visitor. In this letter they say: "We wish once more to express to you our admiration and amazement at the marvelous Exposition which the unparalleled energy of your citizens has reared in Jackson Park. To say that it surpasses in size, beauty, and grandeur any previous international exposition is merely to repeat a threadbare platitude. Your World's Fair does this, but its mission in the work of progress and civilization constitutes its real splendor and its chief value. That it thus gloriously closes the commercial history of the nineteenth century, and thus ushers in the unknown progress of the twentieth, must bring to the city of Chicago and to those great men who have sacrificed themselves to attain this unlooked-for success, a position among the cities of the world that no amount of commercial prosperity and rapid growth could secure. This is the truth it will be our privilege to spread on our return to Europe, and we hope and believe that our testimony may help somewhat to spread the fame of the Exposition abroad and stimulate the interest of foreign visitors."

A new feature of the Fair is an exhibition of the method of saving lives as practiced by the life saving crews. The life saving station has been very popular with visitors, but large crowds now gather when an exhibition is to take place. A mock wreck has been provided; on this four or five sailors will lodge and act as perishing mariners, several times daily. To them the crew on the land shoot the ropes with which the hawser, breeches buoys, and tackle are to be drawn to the wreck and made fast. The crew has already had one real call, and they responded promptly.

SCIENTISTS are now telling us that the dangerous microbe is lurking in the greenback. Those in arrears for subscription, says a contemporary, can send the amount, as he has facilities to disinfect small amounts, and is willing to take the risk.

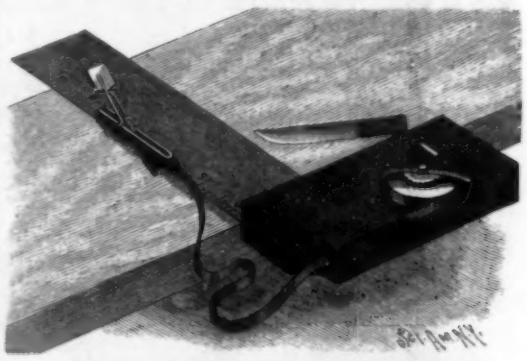
A New Comet.

The new naked eye comet was discovered, in constellation Lynx, at Salt Lake City, July 8, at 10 o'clock by Alfred Rordame. The position of the comet July 10 was about right ascension 8 h. 30 m., declination north 47 degrees. Prof. Swift, of Rochester, who is well known as a comet finder, says the new visitant is a rapid traveler and its motion is west with a daily rate of about three degrees. Prof. Swift says, July 9: "The comet was large and bright with strong central condensation, though no star-like nucleus could be discerned with my four and one-half inch comet seeker. Its tail was straight, exactly opposite the sun, but in consequence of the sky illumination by electric lights, appeared not to exceed three degrees in length." The next night (July 10) he continues: "The tail had considerably broadened, and I fancied had shortened in the interval. As the edges were several times brighter than its inner portion, I concluded it to be a hollow cylinder, as all comets' tails probably are. At 9 h. 50 m. it passed over a pretty bright star, but contrary to a former experience the star was entirely obliterated, showing the comet to be rather a dense one."

As far as can be determined, the comet is a new one and will probably go down into astronomical history under the name of Rordame's comet. According to the orbit determined at the Dudley Observatory, the Rordame comet is receding from the earth at a very rapid rate. It is not likely, Prof. Boss says, to be of much popular interest, though it will be dimly visible for a week yet. It is now about forty millions of miles from the earth and reaches perihelion on July 22.

AN IMPROVED CARPENTER'S SQUARE.

This square, which has been patented by Mr. Frank D. Dunnington, of Buckhannon, West Va., may, in general respects, be of the ordinary construction; but it has an attached marker connected by a line or tape with the square, so that the marker may be drawn along the edge of the blade in marking work, the tape and marker, when not in use, being drawn within the



DUNNINGTON'S CARPENTER'S SQUARE.

handle by a retracting device. The latter preferably consists of a spring-actuated drum journaled in a cavity of the handle, a detent and spring pawl, with projecting knob to be engaged by the thumb or finger, affording means to stop the recoil of the spring when the marker is being used. A light casing is provided for the marker, which consists of a pivoted blade whose point may project beyond either side of the case to mark the work, the other end of the blade forming a handle, shaped to be normally spring-held within the case. An independent additional blade may be arranged as shown, if desired, for convenient movement into and out of the square. This attachment in no way interferes with the ordinary use of the square, as the line and marker, when not in use, are drawn into the mortise or recess of the square handle, with only the handle of the marker blade projecting, so that it can be conveniently grasped.

Steam and Electric Railroads.

A writer in the New York *Sun* notes the fact that notwithstanding all the assistance given to corporations by legislatures, cities, counties, and private individuals, railroad construction in this country was very slow at first. In 1830 there were but 23 miles in operation; in 1832, 229 miles; in 1835, 1,098; in 1840, 2,818; in 1845, 4,633; and in 1848, 5,997. In no single year was the increase in mileage, which now averages 5,000 miles a year, as high as 1,000. But from 1849 to the beginning of the civil war, in 1861, the extension was rapid, the total mileage in 1861 reaching 31,000. Then construction languished until 1870, when 7,000 miles were added, and now the total length is 215,000 miles. On the other hand, the electric railroads have increased with marvelous rapidity throughout every section of the country. At the beginning of 1890, when electric railroad building first began to be popular, there were 200 companies in operation, covering 1,641 miles of track and using 2,346 cars. To-day, so great has been the multiplication of lines that there are more than 7,000 miles of electric street railroads. Three years ago, the mileage of horse roads was 5,713, of electric roads 1,641, of steam roads 554, and of cable roads 527. Now the electric roads lead all others.

Landscaping Treated as a Fine Art.

BY KNUT FORSBERG.

I.—LOCATION.

In this branch of human research, as in all kinds of fine art, nature is our best teacher, but even nature can be improved. The fast surface of the earth is naturally divided into flatlands and highlands, and nobody will pretend that the former, being entirely too monotonous, can be considered as picturesque and worthy the imitation; while, on the contrary, the latter, with their high mountains and bold precipices, their high growths and underbrush, their watersheds and cataracts, and their softer valleys and rolling grounds, constitute Nature's beauty, inclosing fine sceneries, and inviting perspectives into far-away-drawn vistas.

Landscaping from the highest point of view, therefore, should be confined to copying, in miniature, the whims of extravagant and capricious Nature.

In selecting a location for their country homes, people ought to look out for as much undulated ground as possible, with as extensive and many vistas as natural conditions may give opportunity for, and obtain the highest possible altitude for their proposed locations, whence could be contemplated not alone their own grounds, but also the neighboring country. The vicinity of New York abounds in such sites, and I therefore select such a one for my first sketch, as being most desirable, intending hereafter to treat upon less and less beautiful situations, finally to show that even the least favored of natural scenery can be made picturesque and inviting for homes, even if situated below the level of the highways.

A stiff or clayey soil is to be preferred to a sandy one, and the stonier the better, as will be demonstrated below.

In following my profession hereabout I found a knoll of about five acres, which I can landscape in such a way as to give the impression of containing at least 15 acres; it is oblong, with a straight slope of 56 feet toward southeast, 20 feet toward northwest, 35 feet toward northeast and 32 feet toward southwest, without any visible undulation in either descent. On the ridge the soil is a sandy clay, filled with cobblestones. The lower ground is stiff clay, and there is a small swamp which I would make a pond.

The architect's plan of the mansion should be a symmetrical building in Italian renaissance, surrounded by an open piazza, inclosed by a wire netting in summer and by glass in winter, when serving for palmhouses and greenhouses, and located upon a terrace fringed with an Italian trelliswork and having a kiosk in each corner. The house to lie on a hillock 5 feet above the level of terrace, which is laid out in a symmetrical flower garden, from which stairs shall descend 15 feet into the park proper. This much as to the architectural dispositions of the high ground.

In the north corner stables may be located and in west corner the gardener's lodge, with some greenhouses, and the kitchen garden outside the northwestern boundary.

To accommodate the owner and save expense, the topographical survey can be dispensed with, and the roads and walks located by laying a half-inch thick rope some 300 to 500 feet long (the rope to be wetted and stretched before) between the existing clusters of old trees, on easy curves, always allowing the owner to decide their direction until he be satisfied.

The reason why, in naturally undulated ground, the roads must be laid out on curves is that in picturesque nature, rocks, mounds, lakes or streams prevent their being stretched out in straight lines, and, as Nature's own plan should be followed, it will be necessary to construct obstacles for each curve, if they do not exist before, otherwise the curves will seem nonsensical, without motive, with the result that people will cut their own pathways "across lots;" and such shorter pathways only show that the landscaper did not understand his business, for the ground ought to be so shaped that its roads and walks themselves be the shortest possible communications between the given points to be reached by either riding or walking. Roads and walks do not belong to Nature's scenery, but are necessary for men's use and are really not beautiful objects. They should, therefore, be excluded from view as much as possible; at least, two roads should never be visible at once.

II.—ROAD BUILDING.

The roads are proposed to be 15 feet wide, so as to allow two carriages easily to pass each other, and the walks 9 feet, wide enough for three persons walking together to pass two others without separating.

On either side of the laid out rope, and 10 feet apart, stakes 3 inches thick and 3 feet long, or therabout, should be driven to a depth of 2 feet into the ground, so as to stand firmly steady until the work be entirely finished.

Then the top soil should be scooped off to the extent of some 20 feet outside the house building lines, and also from all spots where future grouping of trees and shrubs be desired. The subsoil excavations from building sites should be carried unto the planting spots to create new undulation of the ground, and give motive for the curves of the roads and walks, where every 3 feet higher altitude is marked by the dotted contour lines. This work done, the roads and walks should be excavated, the former 2 feet deep and the latter 1 foot deep; this soil again to cover the filled up mounds before the top soil already taken off be again spread over. Stones ought to be piled in heaps for further use.

On either side of the roads a ditch 6 feet deep and 1 foot wide at bottom should be dug, their earth to be used for fixing the proper grade of the roads and also for making the mounds, and the ditches themselves filled in, from bottom to top, with cobblestones, to free the roads of both underground still standing waters and overground rain water, and prevent any frost penetrating, because such drains act as constant sifts. The ditches of the walks should be made in like manner, but only to 4 feet in depth.

The roads then should be covered with stones 8 inches thick, and macadamized some 3 inches thick, the broken stone to be well rolled down and covered with a stratum of dried and pulverized clay half an inch thick and on the top of this an inch thick layer of coarse gravel be laid and well rolled.

The walks should be covered with a stratum of broken stone 3 inches thick, and be rolled, and filled in with half an inch of dried clay, on the top of which an inch thick layer of pebble stone should be put and rolled down. These pebble stones give the walks that warm yellowish color which looks so inviting in a park; whereas the commonly used bluestone gives them a cold tone which ought to be avoided in a pleasure ground, without mentioning the sticky mud which the bluestone spreads after having been used up for some time.

III.—LAWN DRAINAGE.

Wherever a watershed can be realized, it should be, because nothing more enlivens nature than water, the most precious element on earth. As already has been mentioned, there is a swamp in the lower part of the ground under view, and it, of course, ought to be made a naturally shaped, small lake, where all drainage water can flow. But a lake or pond must have such dimensions that its water does not evaporate too quickly, say at least 15 feet in depth, with as steep shores as possible; these, as well as the whole bottom, to be laid with concrete, so as to keep the water constantly clear and free from unwanted vegetation. The borders of the lake should be as irregular as possible (with visible motive for the promontories), in order that the whole watershed be susceptible of different points of view, when it will be considered to be many times larger than in reality it is. All pond excavations should be saved and used in making the mounds and hills. The pond should be surrounded with a wire netting, and the water surface enlivened with swans and ducks. The overflow of the water can be pumped up and used for fountains, the water again entering the high grounds to return into the pond, and again pumped up.

Deep drainage is of a very great advantage to vegetation. It is well known that no roots enter the still-standing subterraneous waters, and if these waters be led off, at a depth of say 6 feet, the roots of the trees can go to that depth, and, of course, find nourishment from a far greater quantity of soil, while they never can be dried up by the sun, whose heat does not penetrate to such depth. As already said, no quantity of flowing water can be too much for a luxurious high growth, and, therefore, should be made all endeavors to lead higher located spring and well water into the parks, and use these waters at first in fountains, absorbing the carbonic acid from the air, and thus giving fresh nourishment to all vegetation, and afterward additionally, as has been suggested.

Park drainage consists in retaining the rainfalls for as long a time as possible in the ground for the benefit of all high growths, as well as of underbrush and grasses; but that water must be constantly moving, as stagnant water is death to all vegetation, and injurious to human and animal life, whereas flowing water is health and luxury to the whole vegetable and animal world.

To effect this saving of rain water there should be conducted all the waters from the road and walk drains into the lawns, care being taken to do this gradually and so that the water be not carried away too fast, thus useless to vegetation.

One foot lower than the bottom of the road and walk ditches, the ground should be digged and filled in with cobblestones two feet high, covered with a stratum of asphalt, on the sides and on top, thus preventing the entry of earth and sand, but forcing the water in the ground to rise into the drains, and by them be borne away. Then the drains should be covered with earth, taking well care that the top soil be kept always on top.

These covered drains with a down grade of 1 foot on 100 will carry the underground waters slowly to the little pond, and thus the pond will be kept supplied constantly with moving water. Such drainage once carefully executed will stand for all times to come and never need any repairing.

It is an impardonable mistake to build sewers in a park, unless from water closets and restaurants, but the mistake having been made, there is nothing to be done than that was done in all the Paris parks, namely, To introduce artificial irrigation, and also above described lawn drainage, entirely independent of the sewers drainage, or else the leaves must fall off from both trees and shrubs before midsummer shall have come, instead of remaining in luxurious foliage far into November.

IV.—SHAPING THE LAWNS.

Here again there must be followed Nature's examples, as we see them in the rolling grounds, where a hill never finishes in a sharp edge, but always allows the convex form gradually to shape into the concave and *vice versa*. Further, by a clever disposition of the undulation, so that one never shall see neither the whole surface nor all the boundary lines at one eye-stroke, there will be given to grounds an appearance of much greater size than they actually have. But even apart from this consideration, an undulated ground looks always larger than a flat surface of the same size, as indeed will prove to be upon measurement.

In creating such hills and valleys as have been treated herein, consideration must be had of the effect of placing the largest hills along the roads and keeping the smaller ones in perspective diminution.

Even in the choice of grasses the same effect can be reached, where different colors effect the idea of distance, placing nearest those with yellowish tint and farthest away those with bluish pigment.

Of course such effects can only be produced where means permit to sod the lawns with naturally grown grasses—not such as are sown by human hand; but such expense is well paid, when it is remembered that such sods will grow forever, without needing anything but some little manuring from time to time. In selecting the sods, they must be cut on sunny sites for the nearest to the roads situated grounds, and contain just such yellow and red flowers as create the foreground in a picture, and with grayish grasses and bluish flowers for the distances. The sodding beneath and between trees and shrubs should contain such grasses as grow wild underneath trees; and all sod cutting should be made on grounds with similar topsoil and subsoil as where the sods have to be laid.

Such lawns in a park are undoubtedly much more beautiful and attractive than those emerald green ones, which may be entirely on their right spot in small flower gardens and pleasure grounds, but which in no way can be considered as Nature's productive creation. I for one, at least, enjoy the meadow's thousandfold variety before the uniformity of the cut and rolled lawn; just as I prefer the picturesque rockworks on their right position to the polished marble stairs way off in a park.

Sodding should never be made the same year as the shaping of the grounds have been performed, because the new-upturned soil has not been weathered enough, nor received the carbonic acid from the air, which is so necessary for the decomposition of organic matters in all new-turned soil.

The vistas seen from high grounds between ranges of hills over lower and lower grounds also augment the perspective distances at the same time as the hills and their high growth cover up both the unsightly roads and the disappearing incisions of the planting.

KNUT FORSBERG, *Landscape Engineer.*
5 Crystal Street, Brooklyn, N. Y.

Philistine Records of the Hebrew Invasion.

Science contains an interesting account of the Tell-el-Amarna tablets, from the pen of the Rev. Thomas Harrison, of Staplehurst, Kent. These tablets, 320 in number, were discovered by a fellah woman in 1887 among the ruins of the palace of Amenophis IV., known as Khu-en-Aten, between Missieh and Assiout, about 180 miles south of Cairo. They have been found to contain a political correspondence of the very greatest interest, dating from some 3,370 years back. Many are from Palestine, written by princes of the Amorites, Phenicians, Philistines, etc., the burden of almost all being: "Send, I pray thee, chariots and men to keep the city of the King, my Lord." Among the enemies against whom help is thus invoked are the *Abiri*, easily recognized as the Hebrews. The date fixes that of the Bible (I. Kings vi. 1) as accurate. Many names occur which are familiar in Scripture, as for example, Japhia, one of the kings killed by Joshua (Josh. x. 3); Adonizedek, King of Jerusalem (ditto); and Jabin, King of Hazor (Josh. xi.) Very pathetic are the letters of Ribadda, the brave and warlike King of Gebel, whose entreaties for aid are observed to grow gradually less obsequious and more businesslike as his enemies prevailed against him, robbing him eventually of his wife and children, whom he was powerless to protect. But the greatness of Egypt was waning under the nineteenth dynasty: enemies were pressing her at home, and the chariots and the horsemen went not forth.

NEW YORK STATE BUILDING.

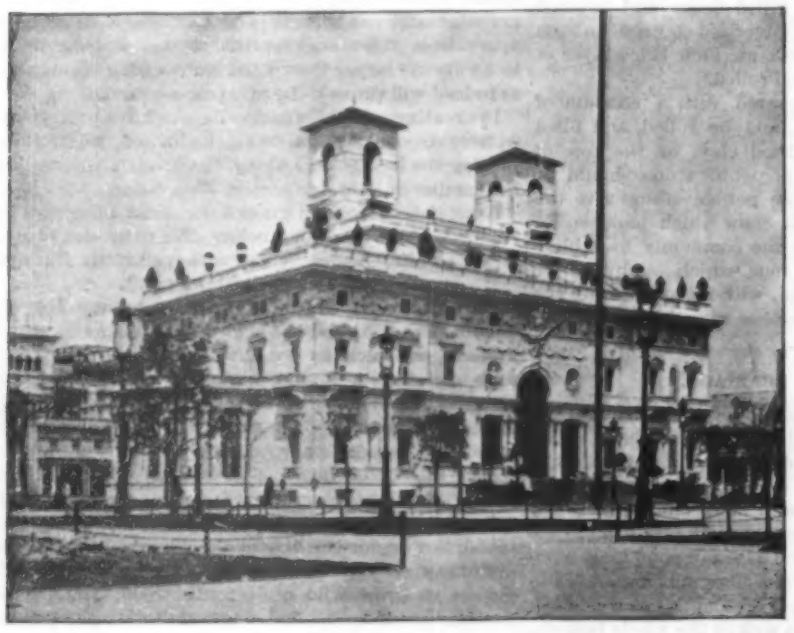
The New York State building at the World's Columbian Exposition is the most imposing and costly of any built by the different States, with the exception of Illinois. The architecture of the New York building might be described as Renaissance with Pompeian motives. It was designed by McKim, Meade & White, of New York City. The expense of the building was about $80,000. It is 214×142 feet, and 96 feet from base to summit of the tower. A magnificent flight of fourteen steps, 46 feet wide, leads to a terrace 80 feet long. In the vestibule are two mosaic fountains, copied after examples in Pompeii. The porticoes at each end of the building are covered with a colored sail, as was the custom in Roman times. The entrance hall is 46×84 feet and is 20 feet high. The mural decorations on the walls of the grand staircase are in the Pompeian style. The walls of the ladies' suite of parlors are covered with light colored silk. Visitors reach the roof by means of an elevator. On the second floor is the reception hall, decorated in white and gold, with a mural painting by F. D. Millet. Other rooms open from the reception hall. The triple terrace roof garden is one of the features of the building. Many of the electroliers in the building are very fine, and at night the building is brilliantly illuminated as the outline stands out in incandescent lamps. The inhabitants of the Empire State may be proud of the building and its contents.

THE OHIO BUILDING.

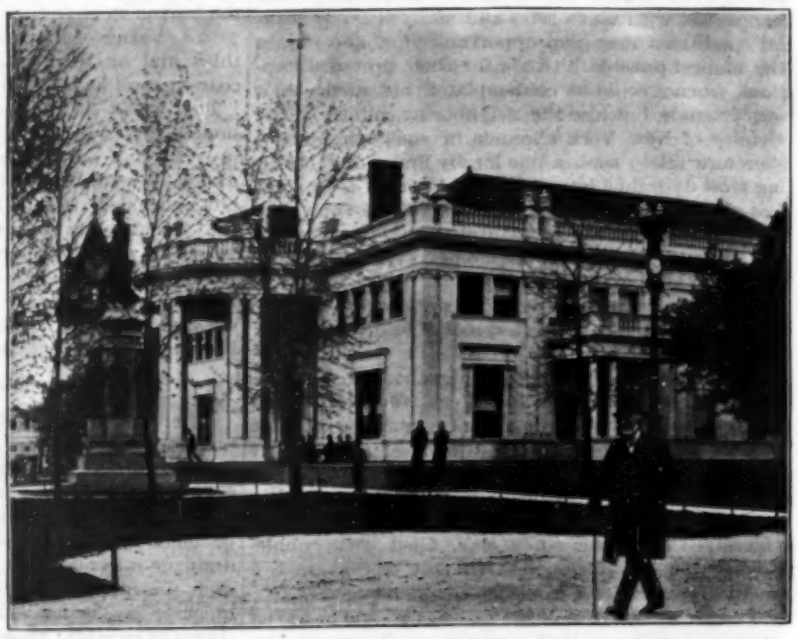
The Ohio State building at the Fair is well situated between the Michigan State building and the Art Gallery. The architecture is of the style of the Italian Renaissance, slightly modified, to give the effect of a colonial building; it somewhat resembles the Executive Mansion at Washington. The architect is Mr. James McLaughlin, of Cincinnati, and the contract price was $30,000. The building measures 100 × 80 feet, and is about 35 feet high. The main entrance is within a semicircular Ionic portico, and a fine open balustrade runs around the top of the building. The roof is covered with glazed tiles. A fine reception hall occupies the center of the building; this hall is two stories in height, and at one side is a large alcove with open fireplace, above which is the State's coat of arms, in stained glass. Rooms are provided for the commission, and for the post office, as well as ladies' parlors, writing rooms, smoking rooms, etc. There is no display of products in the building, as it is strictly devoted to the entertainment of visiting citizens of the Buckeye State.

THE MONTANA BUILDING.

The Montana State building at the Fair was erected at a cost of $16,000 by Galbraith & Fuller, of Livingston, Montana. The design is Roman, the building being one story in height. The building measures 63 × 113 feet, and is built of wood and iron with a covering of staff. The main entrance is 28 × 16 feet; on either side of the large arch are panels containing the seal of the State and the date; these panels are of solid sheet gold; an elk rampant surmounts the arch. The interior finishing of the building is principally in staff and Georgia pine. Though the building is, perhaps, not as richly furnished as some, still it must be remembered that Montana has a very rich exhibit in the Mines building, including the life-size silver statue of Ada Rehan.

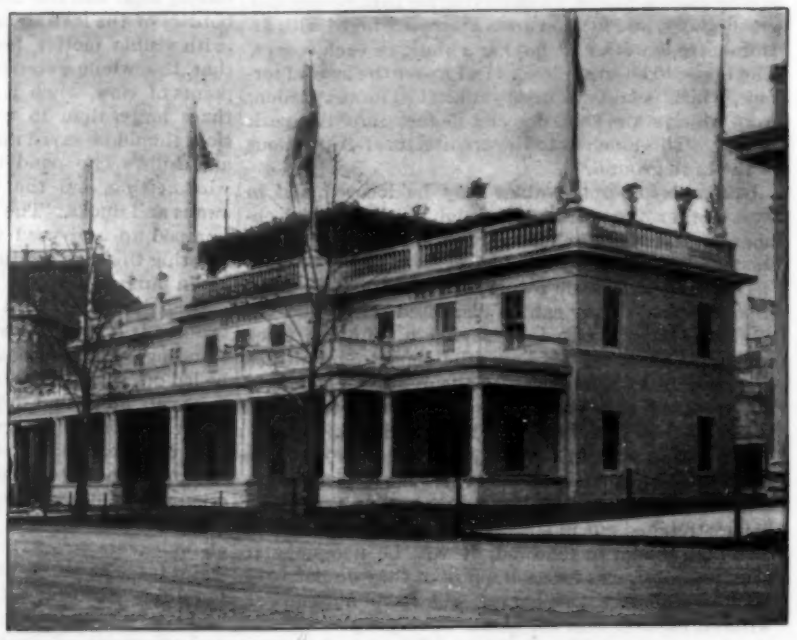


THE NEW YORK STATE BUILDING.



THE OHIO STATE BUILDING.

THE MONTANA STATE BUILDING.



THE ARIZONA, OKLAHOMA, AND NEW MEXICO BUILDING.

STATE BUILDINGS AT THE WORLD'S COLUMBIAN EXPOSITION.

THE ARIZONA, OKLAHOMA AND NEW MEXICO BUILDING.

Arizona, Oklahoma and New Mexico joined together and divided the expense of a neat building for the Fair, which is usually called "The Joint Territorial building." This building was designed by Seymour Davis, of Topeka, Kansas. Like all the State buildings of the far West, the social side of the building must give way somewhat for purposes of exhibition. The display of natural products, manufactures, Indian work, views, etc., is very fine. Though the building may be small, it will not affect the welcome which strangers receive.

Weight per Square Foot of Sheet Metal.

It will be interesting to those who have anything to do with sheet iron boiler plate or similar material to have an easily remembered rule for finding the weight per square foot of material they are working with. It has been found by experience that a square foot of iron plate ⅛ inch thick weighed almost exactly five pounds, and this forms a basis for a very simple and easy rule. As a square foot of iron ⅛ inch thick weighs five pounds, a square foot of ¼ inch iron will weigh ten pounds, and we can say that the area of any sheet iron (or plate iron) in square feet multiplied by the thickness in one-eighths and multiplied by five will give the weight of the piece. There is a piece of tank iron 5-16 inch thick, 3 feet wide, and 5 feet long, how much does it weigh? The area will be 3 feet × 5 feet, or 15 square feet. Now how many eighths is 5-16 of an inch? Since ⅛ = 2-16 and 2 is contained in 5 2½ times, we say 5-16 = 2½ eighths, or 2½ times 5 pounds = 12½ pounds per square foot, and as there are 15 square feet we have 15 × 12½ = 187·5. Where the thickness is even eighths of an inch, it is much simpler; but even this is not a hard thing to do as shown. If it is desired to use this rule for other than iron, we simply find the difference between the weights of the two metals per cubic inch and find what a square foot ⅛ inch thick will weigh, then work as shown above.—*Ironmonger.*

Coffee Glazing.

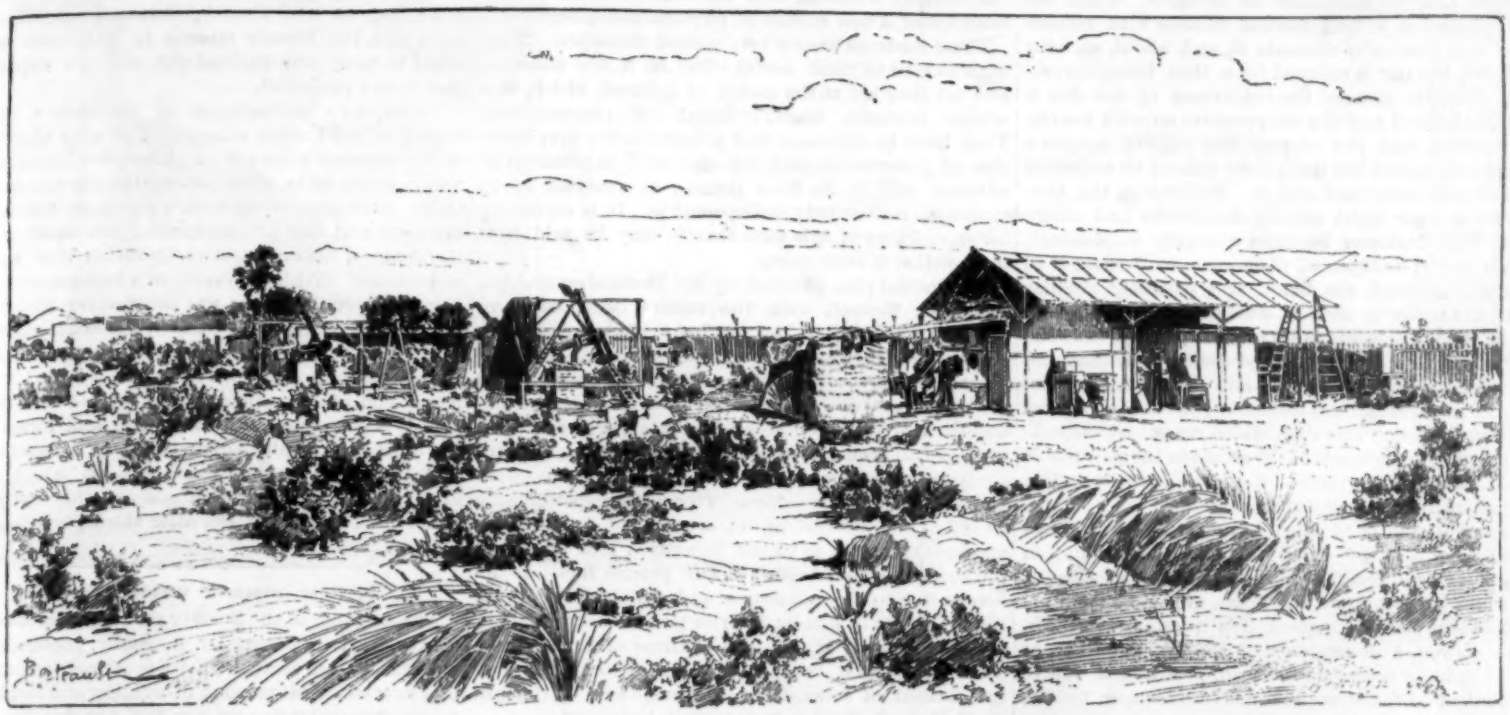
F. Filsinger.—In order to give a lustrous aspect to roasted coffee, a liquid is now in use which is free from color, taste, and smell, and is clear and oily in appearance. It has a specific gravity of 0·868 at 15° C., and burns with a sooty flame, leaving no fixed residue. It absorbs no iodine when treated by Hubl's method, and is but little affected by chromic acid and concentrated sulphuric acid, taking only a slight brown color when treated with the latter reagent. It mixes in all proportions with petroleum ether. It therefore appears to be nothing but a highly purified petroleum oil, and must be considered as an illegitimate addition.—B. B., *Chem. Zeit.; The Analyst.*

THE TOTAL ECLIPSE OF THE 16TH OF APRIL IN SENEGAL.

Total eclipses of the sun, which, in broad daylight, bring on the darkness of night for a few minutes, are very rare in any given place on the earth, and constitute an extraordinary event for all the beings of creation and even for astronomers. The latter, however, are informed in advance, for the progress of what is called position astronomy permits of determining and predicting the exact positions of the sun and moon, and consequently of obtaining in advance the precise moments and places in which the moon will partially or totally conceal the sun. Such perfect knowledge of the celestial motions is due in great part, it must be said, to the work that has been laboriously pursued for the last fifty years in our great national observatory.

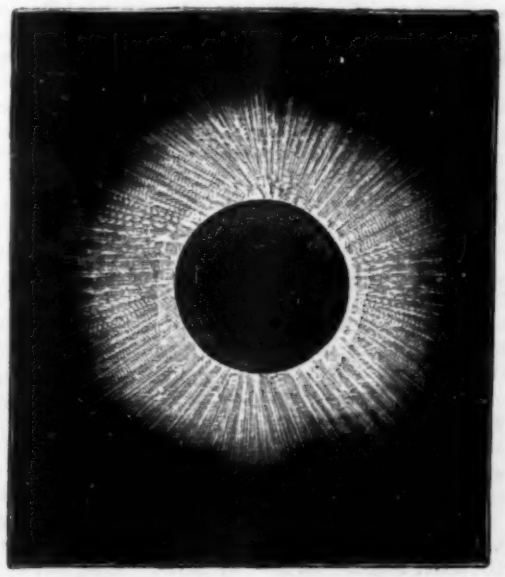
Eclipses are therefore easily predicted at the present time, and, in the very first place, astronomers observe them in order to verify the accuracy of their calculations; but, for such verification, a partial eclipse suffices. Thus, the eclipse of the 16th of last April, which was but partial in western Europe, and in Algeria, was followed with great care at the numerous observatories of these regions.

But when the eclipse is total, and such was the case on the 16th of April in Chile and Brazil and in Senegal, it offers a capital interest to another and entirely new branch of astronomy, which is daily becoming more and more important, and that is physical astronomy. It is, in fact, during the time in which the sun is completely concealed that it is possible to recognize and observe the atmosphere of the sun, in-



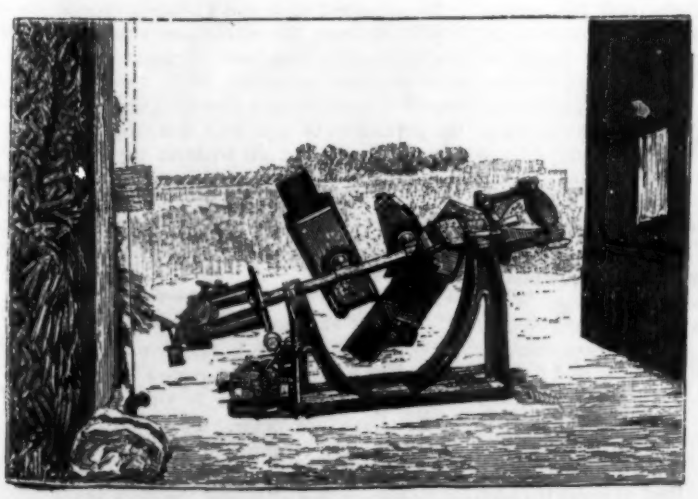
GENERAL VIEW OF THE OBSERVATORY ESTABLISHED AT FOUNDIOUGUE BY THE DESLANDRES MISSION.

APPARATUS FOR PHOTOGRAPHING THE SOLAR CORONA.



THE SOLAR CORONA DURING TOTAL ECLIPSE.

APPARATUS FOR MEASURING THE ROTATION OF THE CORONA.



DOUBLE SIDEROSTAT FOR FURNISHING SOLAR RAYS TO VARIOUS APPARATUS.

AN EQUATORIAL WITH SPECTROSCOPE ATTACHMENT.

ECLIPSE OF THE SUN ON APRIL 16, IN SENEGAL.

visible at ordinary times, and to study its physical constitution. The phenomenon, moreover, is one of the grandest and most astonishing that can be seen, and, at all epochs, has excited the liveliest curiosity, or even great terror. The ancient authors have left us very accurate descriptions of it.

The sun, ordinarily so perfectly round, presents in the first place a slight hollow with circular edges due to the interposed moon, but which is capable at first sight of astonishing one; for the moon, being near the sun, presents to us its non-illuminated surface, and has not been able to announce its presence. Then the moon, which has a very marked motion with respect to the sun, gradually conceals it, and, about an hour afterward, the sun is reduced to a thin luminous crescent. At this moment the brightness of the day is much diminished and the temperature sensibly lowers. The heavens and the surrounding objects assume a strange hue, somewhat livid, that cannot be forgotten by those who have once seen it. Meanwhile, the thin crescent of solar light rapidly diminishes and disappears. The darkness becomes abruptly emphasized, and a new and unexpected phenomenon offers itself to the gaze. Around the black and perfectly circular disk of the moon is seen a wide luminous ring of silvery light that presents in its interior portion, near the lunar limb, parts of a bright red similar to flames. In its external portion, the ring has diffuse edges from which detach themselves luminous jets that are feeble, but characteristic. The ring, which resembles the halo that surrounds the heads of the saints in the pictures of the old masters, has received the name of corona. The red flames are called protuberances.

The apparition is of short duration, seven minutes at the most in the most favorable cases, and in Senegal it lasted but four minutes and eleven seconds. But what is the nature, the cause, of this apparition? Astronomers have discussed this question at length. Is the corona a dependence of the sun, or rather, as several eminent scientists have supposed, is it due to the moon or to the atmosphere of the earth, or, finally, to an optical illusion?

As everything relating to the sun is of great importance to us, various governments have, since 1840, been sending special missions for studying the phenomenon in countries favored by a total eclipse. But the question was not completely cleared up till 1868, thanks to a new method of investigation, viz., that of spectral analysis; for ordinary observations with the simple telescope could not suffice. This method, with special instruments called spectroscopes, composed in general of prisms, analyzes the luminous sources and decomposes them into their elementary colors. Now, by this simple examination, it has the wonderful property of revealing at a distance the chemical composition of the luminous sources, and, through the application of the principle of Mr. Fizeau, permits of determining their motion and the velocity with which they recede from or approach the observer.

The application of the new method during the great total eclipse of 1868 observed in the Indies gave great results. The corona and the protuberances are dependencies of the sun, and constitute what may be called its atmosphere. The protuberances are gaseous flames composed in great part of hydrogen. The corona offers nearly the same gases at a lower temperature and mixed with fine liquid particles and incandescent solids.

But one of the observers of the eclipse went further than his colleagues; after the eclipse he immediately pointed out a simple method that permitted of observing the protuberances in ordinary times outside of eclipses. This great discovery has been fruitful. Thanks to it, it has become possible to explore the immediate environs of the sun at every instant, to follow the formation, the changes and the motions of those protuberant flames that have sometimes dimensions ten times the diameter of the earth, and to recognize the fact that they are due to eruptions of the solar surface and to volcanoes of the sun in relation with the spots and faculæ. Great special observatories have been created in all countries for such study of the sun, insomuch as (according to some authors, Father Secchi among others) these perturbations of the sun have a marked influence upon the general disturbances of our atmosphere.

Meanwhile these successive results with the sun further increased the interest of total eclipses, for the atmosphere of the sun plays in every way a great role in the emission and transmission of solar energy, and it is visible in its entirety only during total eclipses. Daily observation gives only a very small part of it—the most brilliant, it is true.

So all eclipses have been carefully observed for the last twenty years. The English in particular have not neglected one of them. The principal ones in France have been observed by Mr. Janssen and Mr. De la Baume-Pluvinel. As the eclipse of April 16 was one of the longest of the century, the Bureau of Longitudes, which, in France, gives an impulse to astronomical studies, took the initiative of asking the Minister of Public Instruction and the Chambers for special credit for the observation of the eclipse in Senegal.

Two missions even were organized; one for position astronomy and one for physical astronomy. The first mission, the main object of which was not the eclipse, but a special study of the austral heavens, started first under the direction of Mr. Bigourdan, an astronomer at the observatory. It established itself at Joal, upon the seashore, at twenty-five miles to the south of Dakar.

The sole object of the second mission was the study of the eclipse and corona. It was confided to Mr. Deslandres, an astronomer at the observatory, who was recently intrusted with the creation in this establishment of a new service of physical astronomy.

These missions have a very special character. They have to give all their useful effect in a few minutes, and yet they are at the mercy of a cloud, which, at a critical moment, might conceal the phenomenon. They have to utilize as well as possible the very short time of observation, and organize each experiment in advance and in its least details, in avoiding every maneuver not strictly indispensable. It is especially for expeditions of this kind that it may be said that preparation is everything.

The special plan adopted by Mr. Deslandres and the execution thereof, with the results obtained, were recently presented to the Academy of Sciences. Mr. Deslandres organized, in the first place, the observations of the preceding eclipses for the photography of the corona and the study of its chemical composition, and then he prepared several new experiments. He proposed to himself particularly to study by spectral analysis the general motions of the solar atmosphere and to measure its rotation. This latter experiment is delicate, but interesting, on account of the various opinions put forth as to the formation and nature of the corona, in the absence of any precise fact. Is the corona due to the numerous and rapid meteors that traverse it, or is it in its exterior portion assimilable in part to a ring such as one of those of Saturn? In those two cases it would have a rapid rotation, but if it is formed of emanations, the eruptions of the sun itself, it must revolve with a much less speed.

The mission embarked at Bordeaux on the 5th of March with a large amount of material, up to thirty tons in volume, including three large astronomical instruments, a large shed, and the numerous accessories necessary for physical studies. It comprised Mr. Deslandres, head of the mission, Messrs. Millechan and Mittau, his assistants at the observatory, and Mr. Coculesco, a Roumanian astronomer, who joined the mission, but with a special credit from his government and instruments belonging to the latter. Upon reaching Dakar it found a naval advice boat, the Brandon, ready to carry it to the place of observation, and on the 19th of March it landed at the little village of Foundiougue, upon the river Saloun, at ninety miles from Dakar. This station, which had been selected also by an English astronomical mission that arrived later, offers a dry air and pure sky, but it is one of the hottest points in Senegal, where, as in France, the temperature this year in March and April was higher than usual. This excessive heat was the principal obstacle to the astronomers, who had necessarily to work in broad sunlight for a month in order to mount and regulate their instruments. Despite the unfavorable prognostics of the sailors and the people of the country, not a member of the mission was taken sick.

This was fortunate, since, being composed of few members, it would have suffered greatly had one of the latter failed. On the day of the eclipse, but at the cost of great fatigue, the observatory was completely installed, the instruments being ready and well regulated. We give a general view of this installation. The most striking part, at first sight, is a large shed, which was constructed immediately upon the arrival of the party. It merits special mention on account of its lightness and the ease with which it could be put together and taken apart.

The framework was of light iron and the roof of compressed cardboard, after plans by commander of engineers Espitalier, the builder being Mr. Lefort, of Alfortville. This shed rendered the greatest services. As may be seen, it sheltered to the right an office and a photographic laboratory, equally of compressed cardboard, and to the left an apartment containing a large apparatus for the study of the chemical composition and motions of the corona. This apartment is annexed to a special astronomical instrument called a double siderostat. This latter presents at its two extremities two mirrors that send the solar light to the instruments placed in the two neighboring rooms. Moreover, in the center it is arranged for the reception of numerous accessory apparatus. This arrangement of the double siderostat is new. It is simple and has the advantage of furnishing solar light to a great number of apparatus at once.

Farther off, we perceive a large telescope designed for photographing the corona. It is 3 meters in length and has an equatorial mounting that permits it to follow exactly the motion of the heavens. It is derived from the material formerly constructed for the observation of the passage of Venus over the sun, but it was modified for the eclipse. Two smaller telescopes were added to it, giving an image of the sun in the same photographic frame as the large one.

The last apparatus to the left is likewise an equatorial telescope, having an objective of 15 centimeters aperture, and derived also from old material, but arranged for the measurement of the rotation of the corona. At the lower part of the telescope and upon its prolongation is fixed a large spectroscope. Finally, in the background we perceive Mr. Coculesco's apparatus.

On the day of the eclipse the sky was not very pure, being slightly whitish, but nevertheless the two missions, English and French, obtained satisfactory results, and the French mission in particular was enabled to carry out successfully the new experiments that it had projected.

Twenty-two photographs of the corona were obtained by the French mission. The view that we give of the corona is from one of these photographs, which was so taken as to show especially the external part. Other photographs show only the more brilliant interior part and the protuberances. On another hand, the study of the chemical composition that had been undertaken by photography in a hitherto unexplored part of the coronal light was satisfactory, and will permit of recognizing new bodies in the atmosphere of the sun. Finally, the most important research, relative to the rotation of the corona, was crowned with success. The photograph obtained shows that the solar corona revolves nearly like the sun and forms part of it. This last result, which is surely interesting and new, does honor to the French mission, which was the first to take up, and with success, the study of the general movements of the solar atmosphere.—*L'Illustration.*

A New Electric Welding Process.

At a meeting of the Society for the Promotion of Industry, held in Berlin, Dr. A. Slaby, professor at the Technical High School, gave a practical demonstration of a new electrical method of welding and forging iron. In the demonstration an iron bar, forming the pole of a source of electricity, was placed in water containing the other pole. As soon as the iron bar touched the surface of the water, the iron glowed as far as it was dipped into the fluid. Dr. Wedding, who supported the demonstrator, was able to forge the iron thus treated into a rivet. The new process, which is the invention of M. Julien, of Brussels, is carried out on the following basis:

When the poles of a source of electricity are immersed in acidulated water, or water which is made conductive by a solution of salt, and a sufficiently powerful current is passed through, oxygen is given off at the anode (a lead plate) and hydrogen at the cathode (an iron bar). On increasing the strength of the current, the development of gas can be so raised that the iron bar is completely incased by hydrogen, and is no longer in contact with the fluid. As, however, the hydrogen incasing offers a very strong resistance to the current, the electrical energy is converted into heat, by which both the hydrogen incasing and the iron bars are made glowing hot. By this method it is said that temperatures up to 4,000 degrees can be attained. According to Dr. Slaby, there is no difficulty in regulating the temperature for 800 degrees to 1,200 degrees, as required for the forging or welding of the iron, as the degree of heat depends on the proportion of the size of the anode to that of the cathode, as well as on the available electric pressure. On these grounds there is claimed for the new invention a great advantage over the Benardos process. In this the light of the electric arc is used for heating the iron. As, however, it has hitherto not been possible to properly adjust the heat, the points of welding present an uneven appearance, owing to the iron being partly burnt. The Benardos process is, consequently, only used in such cases where the joint can be subsequently touched up.

As compared with the Thomson process, the new one is said to have the advantage that with a tension of 100 to 200 volts, iron bars of two to three centimeters diameter can be welded, while the Thomson process requires exceptionally powerful currents, which cause the process to be dear and dangerous. The new process can be carried out without any particular difficulties. Any one having an electric light supply can make the experiment for himself. For the anode, as large a lead plate as possible is taken. The socket in which the iron bar is held forms the cathode.—*London Electrical Engineer.*

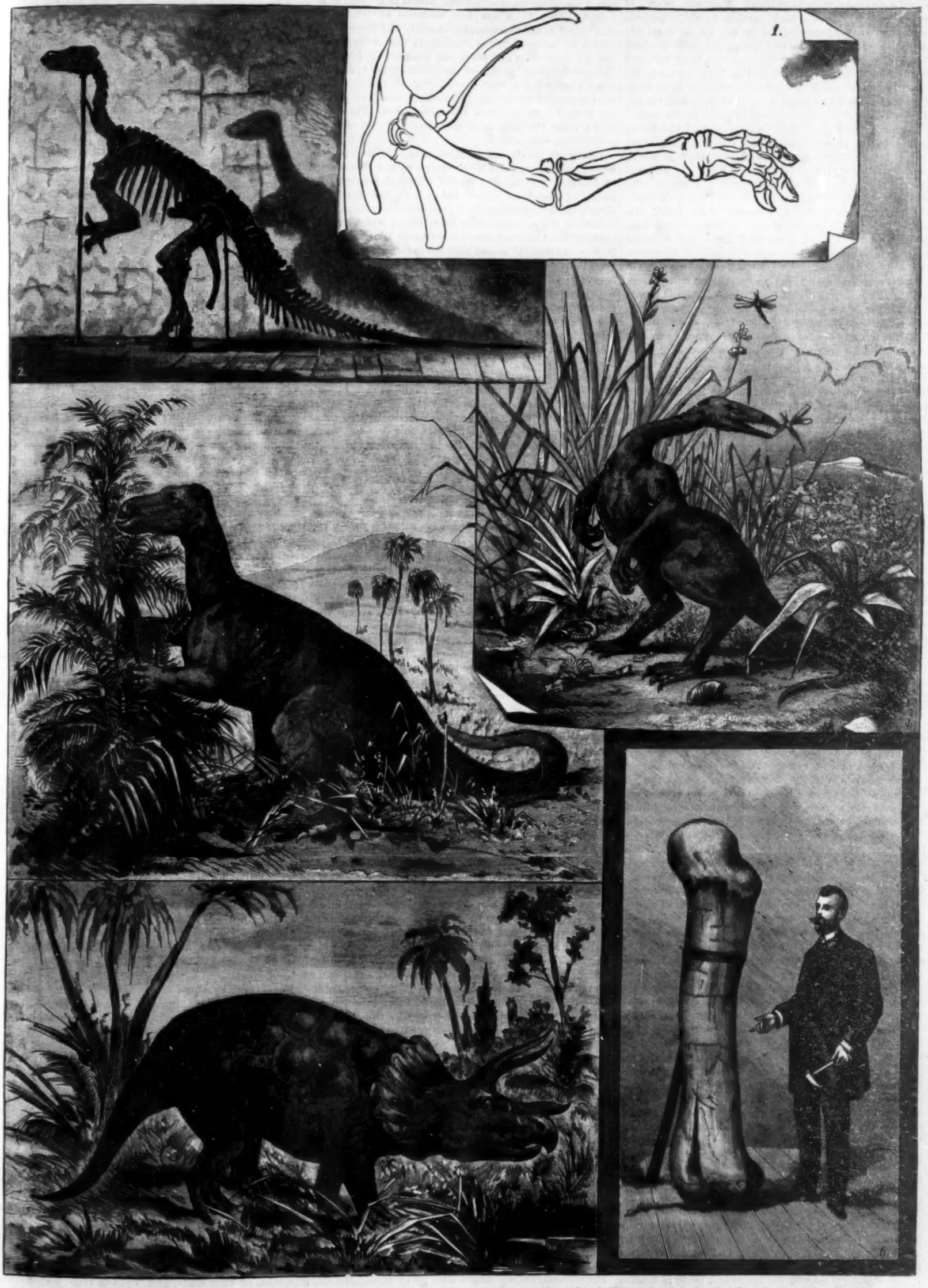
Hatching of Lobster Eggs.

Through some mistake the New York State Fish Commissioners had been purchasing lobster eggs that had, by chilling and other causes, become sterile and, of course, no hatching took place. This year L. D. Huntington, the president, established three stations—at Lloyd's Neck, Mattinacock, and New Rochelle—where the lobsters are secured alive and the eggs taken from them. Up to June 21 about 1,200,000 eggs were obtained from these places, and they were found to hatch readily. The commissioners expect to be able to distribute at least two and a half million lobsters this season.

ANTEDILUVIAN MONSTERS.

Fifteen years ago, when the deep cut was being made in the Erlenberge above Kaltenthal, during the construction of the railroad between Stuttgart and Vaihingen, the workmen and engineers were much surprised to strike bones as large as those of a large elephant, embedded in rock, and evidently belonging to some antediluvian inhabitant of the neighborhood of Stuttgart. These fossils were removed with great difficulty, for the old giant whose rest was being disturbed seemed to have set the whole mountain in motion. The pieces of rock were packed in boxes and wagons and carried to the Royal Natural History building, where months were devoted to the work of chiseling the bones out of the rock, and then putting them together as much as possible. This nearly perfect skeleton is now an ornament to the museum, where its enormous dimensions excite the wonder of visitors.

In order to get a correct idea of the shape of the animal and construction of the skeleton, a great deal of study and comparison with other animals of simi-



1. Pelvis and Hind Foot of the Iguanodon. 2. Complete Petrified Skeleton of an Iguanodon in the Brussels Museum. 3. Compsognathus, a Jumping Dinosaurian of the Jura Period. 4. Iguanodon from the Forest Formation of Belgium. 5. Triceratops, a Horned Dinosaurian from the American Jura. 6. Thigh Bone of the Atlantosaurian (American) that Measured 121 Feet.

DINOSAURIANS OF THE PRIMITIVE AGES.

lar species were required, and but for the information gained from similar fossils dating back to the time between the Jura and the chalk periods and found in Belgium, it would have been very difficult to get a perfect understanding of the "Swabian dragon," or zanclodon, as scientists named it, on account of the resemblance of the sharp, crooked teeth to a vine dresser's knife. Not less than twenty-one skeletons were excavated near Bernissart, Belgium, some of which were perfect and had petrified in their natural positions, so that they could be set up as complete skeletons as soon as they had been freed from the rock that surrounded them. Fig. 1 shows a hind foot and Fig. 2 a complete skeleton that has been set up in the court of the Brussels Museum, because it is so large that it could not be placed in any of the halls for collections. It belongs to the great iguanodons, so named from their sharp teeth, similar to those of the living iguana lizard, reptiles measuring about twenty-eight feet, that were quite numerous during that period in north Germany, Belgium, and England. It will not be difficult for even the unscientific observer who stands before the Brussels skeleton to form a comparatively clear idea of the appearance of an iguanodon when alive. It is only necessary to imagine the mass of bones covered with flesh and skin. Fig 4 shows one of these monsters restored, and we look with wonder and horror at a creature that combines the form of a lizard or saurian with the movements of many mammals. It stood on its hind feet, being supported partly by its great tail, while its fore feet were used for securing nourishment, which consisted mostly of plants. We seek in vain among the members of the early animal world for a creature that approaches our iguanodon in form or size.

But, before considering these monsters and their life more closely, it is necessary to picture the time when they were monarchs of the animal kingdom. We reach back into the darkness of the primitive world, which was in existence long before it was trodden and ruled by man, the period that the laity like best to call antediluvian. The historian reckons dates of events by the Scriptures and other documents, and the archeologist uses monuments and art treasures to calculate time to within a hundred or a few hundred years; but, in studying the history of the earth in its primitive ages, time is not reckoned by years, hundreds of years, or even thousands of years, but by geological periods, that are not of an absolute, but only of a relative length. The monuments and documents are contained in the earth's crust, of which the strata, corresponding to different periods and piled one upon the other, give us a glimpse of the fauna and flora of those times. The sciences that strive to solve these problems are geology and paleontology, and study of the earth and her animal kingdom.

Geology teaches us that the world is very, very old, older than we men can conceive, that here, as in the great proportions of the heavens, we find everything "endless," beyond the comprehension of man. Geology teaches us further that the time of man is only the last and shortest period in the development of the world, that before the appearance of man, in the tertiary period, mammals of more or less development reigned supreme. As a rule, the farther back we go, the less development we find. Before the tertiary period was the secondary or mesozoic period, while the beginning of life on the earth and the rule of the animal world is called the primary or paleontological period. We now have to do with the mesozoic period of the earth's history, in which we find the first trace of the mammals, and, naturally, we find here also a mass of lower animals. But the reptiles or saurians were monarchs of the animal world, having attained a wealth of species and development with which the reptiles of the present time cannot be compared. Not only have the different species disappeared or changed, but whole orders lived then of which we have no representatives now. I will mention only the well-known fish saurians, to which belong the dolphin-like ichthyosaurians, the long-necked plesiosaurus and the snake-like mosasaurus, and the flying saurian, that dragon-like creature that recalls the bat. The group of saurians represented by our engravings is an entirely extinct species, belonging to the dinosaurians, so named on account of the great size and extraordinary form of these animals. The wildest fancies of the middle ages could scarcely have pictured more dreadful dragons than that we find in this group of animals, some of the members of which are lizards with little heads and long tails, and some have bodies of a more compressed construction, with great skulls more than a yard long, and long legs, and finally there are strange species that stand upright and jump, representing the kangaroo or the jerboa among the saurians.

The oldest dinosaurians that we know of belonged to the triassic formation of the first part of the mesozoic period, and the best are from the marl in which the zanclodon spoken of above was found near Wurtemberg. It was an immense upright beast of prey, measuring 28 feet in length, its claws and teeth indicating the carnivorous animal.

In the Jura formation that followed discoveries have been rare in Europe, and do not begin to increase until the end of this period. We will mention only the megalosaurus, which followed the zanclodon, but was much larger, its upper thigh bone alone measuring 3 feet 3 inches, and its jaw being provided with double-edged teeth. Even more interesting than this giant was an inhabitant of the shores of the Jura Sea, which then spread over the greater part of Germany. We mean the little compsognathus, which is shown as restored in Fig. 3. A complete skeleton of this animal was found in the lithographic stone of Kehlheim, from which we see that it was scarcely 24 inches long, with quite a large head and hind feet adapted for jumping. It is the smallest species of the dinosaurians, and the most nimble in its movements. Of all the creatures that belonged to the epoch following the Jura period, we should mention first the iguanodon. Figs. 1, 2, and 4 show the specimen mentioned above and the creature as restored.

The small number of saurians found in Europe has been greatly surpassed by the more recent discoveries in America. Along the Rocky Mountains there is a girdle of limestone which belongs to the Jura and earlier chalk formations, and here the unnumbered specimens of dinosaurians have been found which are the pride of the American museums, especially the museum in New Haven. It would take too much space to touch even lightly upon the features of the species that have been discovered in America, and of which whole skeletons have often been found, so that the beast could be reconstructed with certainty, as the iguanodon had been reproduced. Here we can mention only two kinds that are shown in our illustration: first, the atlantosaurus, the great giant of the dinosaurians, the upper thigh bone of which is 6 feet 6 inches long and 24 inches thick at the upper end. It is hardly possible to conceive such a "moving mountain," for it is estimated that this monster was 131 feet long and 22 feet high. These dimensions are much greater than those of any other known animal. The largest whale that was ever measured was only 98 feet long, and the largest beast that lives on land, the elephant, only 22 feet to 26 feet (from tip of trunk to tip of tail). The atlantosaurus lived on plants. It had a remarkably small head, long neck, and a long body that rested on long, strong legs and a long, powerful tail.

The species shown in Fig. 5, the triceratops horridus, was also very large, measuring 59 feet to 65 feet. It is of a very peculiar type, resembling the rhinoceros, this resemblance being due especially to the monstrous skull, which is about 6 feet 6 inches long and has three horns, one on the nose and two on the forehead; behind these horns is a strong shield with spikes that protects the neck, and the body was also protected with bony spikes and plates, which increased the terrible impression made by the beast.

But enough of these terrible animals for to-day, and let us rejoice that the time when the earth trembled under their heavy tread is passed, and still more in the steady progress of science, which enables us to throw more and more light on the primitive ages of the world and to again bring to the daylight the uncanny reptiles that gave their stamp to those times.—*Dr. Eberhard Fraas, in the Illustrirte Welt.*

Tropical Roofs.

The natives of the interior of Ceylon finish walls and roofs with a paste of slaked lime gluten and alum, which glazes and is so durable that specimens three centuries old are now to be seen. On the Malabar coast the flat bamboo roofs are covered with a mixture of cow-dung, straw, and clay. This is a poor conductor of heat, and not only withstands the heavy rains to a remarkable degree, but keeps the huts cool in hot weather. In Sumatra the native women braid a coarse cloth of palm leaves for the edge and top of the roofs. Many of the old Buddhist temples in India and Ceylon had roofs made out of cut stone blocks, hewed timber, and split bamboo poles. Uneven planks, cut from old and dead palm trees—seldom from living young trees—are much used in the Celebes and Philippines. Sharks' skins form the roofs of fishermen in the Andaman Islands. The Malays of Malacca, Sumatra, and Java have a roofing of attaps, pieces of palm leaf wicker work, about three feet by two in size and an inch thick, which are laid like shingles and are practically waterproof. The Arabs of the East Indies make a durable roof paint of slaked lime, blood, and cement. Europeans sometimes use old sails—made proof against water, mould, and insects by paraffine and corrosive sublimate—for temporary roofs.

Cement for Steam Pipes.

Another cement of specially valuable properties for steam pipes, in filling up small leaks, such as a blow hole in a casting, without the necessity of removing the injured piece, has been compounded. The cement in question is composed of 5 pounds Paris white, 5 pounds yellow ocher, 10 pounds litharge, 5 pounds red lead, and 4 pounds black oxide manganese, these various materials being mixed with great thoroughness, a small quantity of asbestos and boiled oil being afterward added. The composition, as thus prepared, will set hard in from two to five hours, and possesses the advantage of not being subject to expansion and contraction to such an extent as to cause leakage afterward, and its efficiency in places difficult of access is of special importance.

An Interview with Jacquard nearly a Century Ago.

The Jacquard machine, as is well known, permits the weaving of the most complicated patterns, enabling manufacturers of textile fabrics to produce the most tasteful and elegant goods at a price within reach of all classes. This most ingenious machine was the invention of Jacquard. Long years ago, we paid the old man a visit, and he welcomed us with heartiness. "But," said he, "come forth into my vineyard; let us get among the grapes and sunshine." So he led the way with tottering steps, and, sitting down by his side, I told him I was an Englishman, and, as he was a most ingenious man, I had come to see him. "Well, I am proud of a visit from an Englishman. If I have done any real good, I owe the first suggestion to England. It was an English newspaper that led me to occupy my thoughts with mechanical improvements, and, but for that, it is probable I should still have been a poor straw hat maker in some obscure street in Lyons. It was during the peace of Amiens that a translated extract from an English newspaper met my eye offering a premium, by some society in London, to any one who could apply machinery for the production of nets. After many attempts, I made a machine which produced a perfect net and, somehow, thought no more about it. The net I carried about with me in my pocket, and one day the question was put to me by a friend what would I do with my machine. I gave him the net as my answer. Time went on, and I was surprised at receiving an order from the prefect to see him as soon as possible. I went: he produced my net and said, 'I have orders from the Emperor to send your machine to Paris.' 'From the Emperor! That's strange! You see it is all in pieces and I must have time to put it together again.' Very soon I managed the affair, and trudged off with it and a half-made net to the prefect. I bade him count the number of loops and then strike the bar with his foot, when another loop was added to the number. Great was his delight—and the interview ended by the words, 'You shall hear more about this than you are aware of just now;' and I did, in a way that perplexed me not a little. The prefect sent for me and said, 'You must go to Paris, M. Jacquard, by his Majesty's orders.' 'To Paris, sir! How the deuce can I? What have I done?' 'Not only must you go to Paris, but to-day, immediately.' 'Well, then,' I answered, 'I will go home, see my wife, pack some clothing, and—' 'You will not go home, there is a carriage now waiting to take you; my orders are imperative to send you on at once; I will provide you with money and all you require.' I jumped into the carriage and away, full gallop, to cover the 150 leagues to Paris. At the first station, I opened the door to step out, but was stopped by a gendarme. 'Sir, if you please, you are not to go out of my sight.' I found myself a prisoner. On we went, and for the first time in my life, I found myself in Paris, and strange, indeed, was my introduction there. Having been taken direct to Napoleon and Carnot, the latter said to me suddenly, 'Are you the man that can do what Omnipotence cannot? Can you *tie* a *knot* on a *string* on the *stretch*?' I was confounded, and could not answer. The Emperor said, 'Don't be bashful, my man, speak up. I will protect you.' In answer I said, 'Give me materials and some place as a workshop and I will try what can be done.' At the time a superb shawl was to be woven for the Express Josephine, and for its production they were constructing a very costly and complicated loom, upon which the sum of twenty thousand francs had already been expended. I recollected having seen a model by Vaucanson, in which was a principle I thought might be made to serve a purpose I had in my mind, and, after intense application, I produced the machine bearing my name. The Emperor conferred this decoration upon me which you see upon my breast, and a pension of one thousand crowns. But, on my return to Lyons, I was received by an infuriated mob of weavers, who declared that I had doomed them and their families to starvation. Three plots were laid to assassinate me, and twice, with difficulty, I escaped with my life, and so strong was the prejudice against me, that my machines were openly destroyed by order of the public authorities in the great square of the city. The iron was sold for scrap, the wood for fire lighting. Trade declined, owing to the successful competition of foreigners, and, as a last resource, I was begged, entreated, and continually supplicated, to make another experiment. I succeeded; silks of greater beauty were produced at a lower cost; the dawn of prosperity set in and continued to shine. I have lived to see thousands made. It has given labor to tens of thousands, and I thank God who gave me the intellect and preserved my life to be a public benefactor."

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(5189) C. F. W. asks: 1. Would it be practical to run a one horse power motor by storage batteries, charged by cell batteries of some kind, if the motor only has to run about five hours per week? A. Yes. 2. Does it take more cells of battery (storage battery) to run a motor a day than it does an hour? A. Yes. One set of cells will run a motor for about 6 hours; for 12 hours you would need two series of cells. 3. Will it take more cells of battery to charge the storage battery when the motor runs all day than when it runs only about one hour a day? A. It would hardly be feasible to charge a storage battery for all day running by means of primary batteries, but it would be practicable to do so for a run of from one to six hours. 4. Is the armature stationary in a "multiphase" motor? A. Yes. 5. What is a "three-pole" motor? It is a machine having an armature provided with three radial poles. 6. What is the oil to lubricate printing presses and such machinery? A. Machinery oil of good quality.

(5190) M. T. B. asks: 1. Is there any substance suitable for a small mirror which is flexible? A. Flexible mirrors of glass have been made. 2. What is the explosive force of an ordinary 45 × 70 405 grs. cartridge in the chamber of a rifle to the square inch. Is there more force backward than sidewise? Also, how much more will the same bullet drop in a thousand yards shooting over water than land, also how much higher will it shoot in an altitude of 8,000 ft. than at sea level? A. The explosive force of good rifle powder is about 30,000 lb. per square inch in every direction. We have no data as to any difference in the trajectory of a bullet over land and water, or at high altitudes. 3. How many times stronger is gun cotton than F. F. G. black rifle powder? A. The explosive force of gun cotton is from 40 to 60 per cent greater than rifle powder for equal weights.

(5191) H. E. C. writes: 1. I am making commutator for a simple motor out of segments. Will iron or brass do for flanged sleeve. If not, what is best? A. Brass will do for the flanged sleeves, but copper is preferable. 2. I have made a motor with cast fields and wrought iron rings for armature core; what metal must be used for mortised studs for holding brushes? A. Brass is commonly used for this purpose. 3. Is there nothing I can substitute for rubber lining in plunge battery cells? A. Try coal tar pitch. 4. Will one cell start motor? A. Yes. 5. Would 10 cells with plates 3 × 5 have any more E. M. F. and volts than a battery of 4 or 6 cells of 6 × 10? A. The E. M. F. of the bichromate cell is about 2 volts, whatever the size of the cell. Larger plates yield more current. 6. Is it necessary to solder joints in winding magnets? I filed wires and spliced and put tape around; will that do? A. It is advisable to solder all joints of conductors on either field magnet or armature of dynamos and motors.

(5192) J. J. C. writes: 1. What seemed to me to be a very curious occurrence last Wednesday night, being a very heavy storm, the lightning struck the electric light wires leading into our church. The sexton, a young man, going down in the cellar next morning, was about to turn on the light, but as soon as he touched the key, he was knocked across the cellar and almost stunned; but the strange part of it is you cannot touch the lights to turn them on ever since. I tried it Sunday night, but I got a shock which made me leave them alone. The electrician of the company was there, he touched one with a piece of wood, and he also got a heavy shock; now what do you think was the cause of all this? A. Possibly the lightning destroyed some of the insulation, so that the electric light current reached the key. The wires could not retain the charge of lightning for more than an instant. 2. In the steel-melting shop where I work, we have considerable trouble with the bottoms in the moulds; you know the steel is poured from crucibles into moulds, which are made out of cast iron, and also the bottoms; the weight of the steel striking the bottom in the moulds eats the bottom away, so they only last a few heats, which makes them very costly. We have tried a great many different devices, but all about alike; now what do you think would remedy this defect? A. Try inclining the ingot mould so that the steel will strike the bottom with less force.

(5193) A. S. J. writes: Lightning committed a freak here to-day. At 10 o'clock during a very heavy rain there was one flash of lightning. The bolt struck a flue in the kitchen of W. W. Baird's residence, followed it down to the stove pipe, down that to the stove, demolishing everything as it went. The matched board hard pine floor is not marked in the least, and there is no sign about the room where the bolt passed out, but directly under where the stove stood the ground is torn up, leaving a hole in which could be placed a barrel. The flue ran from the ceiling of the room through the roof, not from the ground up. How did the lightning get through the floor without leaving a mark? A. Possibly the lightning followed a nail through the floor, or the disturbance in the ground may have been caused by a branch discharge or another bolt.

(5194) H. D. R says: 1. In two guns, bore 1 inch and 1¼ inch, please state the maximum amount of gunpowder that can be burned in each. A. Much depends upon the strength and length of the gun, and also upon the strength of the powder. As to the maximum charge, possibly a quarter pound for the 1 inch gun and 6 ounces for the 1¼ inch gun is as much as can be used effectively. 2. How is the above computed? The computation involves all the conditions of composition of the powder and the strength and length of the gun.

(5195) J. H. S. asks: 1. How to gild the edges of books? A. The edges of books are gilded by sponging with white of egg and laying on gold leaf; when dry, burnish with an agate burnisher. 2. The general principles of combination locks? A. The principles involved in combination locks is a very intricate one to answer in a letter or Note and Queries. 3. How to stop leaks around the fittings of steam pipes where it is impossible to take them down? A. Clamps and rubber packing is the usual practice for stopping leaks as you describe.

(5196) A. M. says: Having built an engine with 3 cylinders (steam one way only), cylinders are 1 inch by 3¼ stroke, and makes about 250 revolutions with 7 lb. steam per minute, how much horse power will it have with 50 lb. of steam, and how many revolutions will it make, there being no dead center? A. Your engine as described is about ¼ horse power; 3 cylinders 2 inch diameter, 5 inch stroke, will be the size for 2 horse power. 2. What size cylinders will be necessary for a 2 horse power engine, *i. e.*, using 3 cylinders, also please give dimensions of a tabular boiler for the same? See SCIENTIFIC AMERICAN SUPPLEMENT No. 702 for types of small boilers ½ to 2 horse power.

(5197) A. H. says: The propeller on my steam launch is a four-bladed one. It is 18 inches in diameter, and the blades at the circumference are set at an angle of 45 degrees. Will you please inform me the pitch of the propeller, and what per cent the slip is generally allowed in still water? A. The propeller is 4½ feet pitch. The slip will be governed by the size of the boat and its model, which is the measure of resistance; about 20 to 25 per cent slip should be allowed.

(5198) S. J. R. asks how much approximately a brass rod 50 feet long will expand with an increase of ten degrees in temperature, and what weight would it lift? A. The brass rod will expand 0·065 of an inch for the length and change of temperature named. Its lifting weight will depend upon its size and bracing to keep it from buckling.

(5199) E. W. asks: Will a Bunsen 1 gal. battery run a motor 20 to 30 hours with load? A. A Bunsen cell will run a motor for the time named, provided the resistances of the motor and battery are proportionate.

(5200) A. C. W. asks: Is it possible to run a storage battery, charged with closed circuit batteries, so that it can be used at any moment for lighting purposes, so arranged by switches that the closed circuit battery is cut out from the storage battery and storage battery turned on to the light? If so, what is the effect on each battery, if any? How long will each battery last? A. You can arrange storage batteries in connection with primary batteries in the manner suggested. A storage battery of good make will last almost indefinitely, and gravity cells used for charging will run a year with little attention.

(5201) H. V. H. asks: 1. Would the magnetic key described on page 478 of "Experimental Science," and the simple polarized bell, page 486, work well as a call for the simple telephone, page 577? A. Yes. 2. Would it be better or cheaper than a bell operated by a battery? The telephone line is to be about half a mile long? A. Probably it would; but we think a magneto call would be preferable to either. 3. What size of spools and wire would be required for the polarized bell? What weight of wire would be required for the telephone? The key? The bell? What should the wire cost? A. Use No. 36 wire for the magnet of the bell, and make the resistance of the magnet 200 ohms. This will require about 500 feet of wire. The resistance of the key should be about the same. We believe the wire costs about 75 cents an ounce.

(5202) W. J. B. says: I have a ¾ inch water pipe, with 35 to 40 pounds pressure per square inch. Now I would like to know what size water wheel and what size jet I would have to use to drive the hand power dynamo (SUPPLEMENT 161). I have removed the copper plating from electric light carbons with nitric acid. The acid has seemed to have soaked into the carbon. Will this do any harm if used in the battery, or what will take it out if not? How many gravity cells would it take to run an induction coil, size 6 inches long and 1½ inches in diameter? A. You will require a 12 inch water motor, with a half inch nozzle, to drive the dynamo; about one-eighth horse power. The nitric acid absorbed by the carbons will do no harm in the battery. Four gravity cells for the induction coil.

(5203) W. A. F. asks: 1. Would like to know if it is possible for me to recharge the exhausted cells of the chloride of silver dry cell Faradic battery? If so, state how and what wanted. A. A chloride of silver cell can be charged by removing the reduced silver and replacing it with a cylinder of fused silver chloride. The solution is made by dissolving pure chloride of ammonium in water or, in lieu thereof, common salt. 2. Is it possible to make a chemical battery strong enough to run a phonograph and not be larger than 12 inches square? If so, what material is required to construct same? And what ingredients are required to run the ordinary length of time? A. A good sized Grenet battery will run a phonograph. The solution for the Grenet battery is made by dissolving bichromate of soda in water to saturation and adding slowly one-fifth its bulk of commercial sulphuric acid.

(5204) L. B. asks: 1. Can the field magnets of an alternating current dynamo be excited by storage batteries capable of supplying continuous circulation? A. Yes. 2. Can an Edison dynamo be changed from manufactured state to alternating current dynamo by simply having a ring commutator? A. No. 3. Are electric incandescent lights commonly used run by alternating current? And if so, could they be run by continuous and interrupted currents, and what will be the result of each system? A. Incandescent lamps are run in both ways. The difference in the results is not noticeable.

(5205) F. H. asks: 1. What kind of battery to use to ring a 2¾ inch electric bell continuously? A. Probably the Fuller battery would answer your purpose. 2. Will a disk Leclanche answer? A. We think this battery would polarize in a short time. 3. How long would a disk Leclanche ring it? A. This battery will usually polarize so as to be inoperative with about an hour's use.

(5206) W. H. F. writes: I have made the telephone described in SUPPLEMENT 142, and it works fine. But how in the world can I give a signal on the same? It can't be done by tapping on the diaphragm. It don't produce noise enough to call up. A. Place a switch at each end of your line and use a magneto call, or a battery, push button and electric bell.

(5207) S. C. K. asks: 1. What should be the proper surface speed at which the wax or tinfoil cylinder of a phonograph should run? A. Its peripheral speed should be about 50 feet per minute. Also what is the area in circular mils of a copper wire to carry one ampere of current? A. 642·47. 3. Is the carrying capacity in direct proportion to the sectional area? A. Yes. 4. What is the resistance of Grenet battery solution? A. The resistance of a Grenet battery of one-half gallon size is about one-half ohm.

(5208) F. H. asks: Which will leak through the smallest opening, water or steam, the pressure and temperature being the same, say 70 pounds and 320 degrees Fahrenheit? The claim has been made that water will. A. It is generally conceded that steam will pass through holes or spongy material that is impervious to water under the same pressure. Its issue is not as readily observed as with water.

(5209) A. G. F. asks: Does it in any way reduce the pressure on a station pump, lifting water 300 feet vertical, by tapping water column 10 feet above discharge valves and allowing the full of a 2 inch pipe to return to the sump, provided the main water column is always full to point of discharge? Is not the pressure the same at discharge valves, less the friction of escaping water through the 2 inch pipe? A. The discharge pipe from the main will lessen the work of the pump in the proportion of water diverted from the main pipe, and only lessen the pressure on the pump valves by the amount of the friction head due to the decreased velocity of the water in the main pipe. It is not an economical device.

(5210) A. M. asks: Give the proportion of a small brass cannon with a one-half inch hole, so as to be perfectly safe. A. For one-half inch bore make the cannon 6½ inches long, 1½ inch diameter at muzzle, 2½ diameter at breech.

(5211) F. X. S. asks how to make Gurley's Norwegian dipping compass, how long to make the needle, and if the jewel bearings out of a watch will do for the bearing. A. The needles of dipping compasses are made from 2 to 4 inches in length. You may use jewels as you propose, or you may employ fine knife-edge bearings, such as are used in fine scales.

(5212) L. B. writes: Have seen a statement in Gage's "Element of Physics," that sometimes telegraph instruments are worked without any battery in circuit, but merely connected with the earth. If electricity can be taken in that way, please explain how, and if not, what is meant by this statement. A. It is only under peculiar electrical conditions that telegraph instruments can be worked by earth currents. It is not possible, at any time and at any place, to take sufficient current from the earth to operate a telegraph instrument.

(5213) G. B.—You will find a complete rule for finding the day of the week for 6,000 years, including the full centuries, in SCIENTIFIC AMERICAN SUPPLEMENT, No. 879.

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